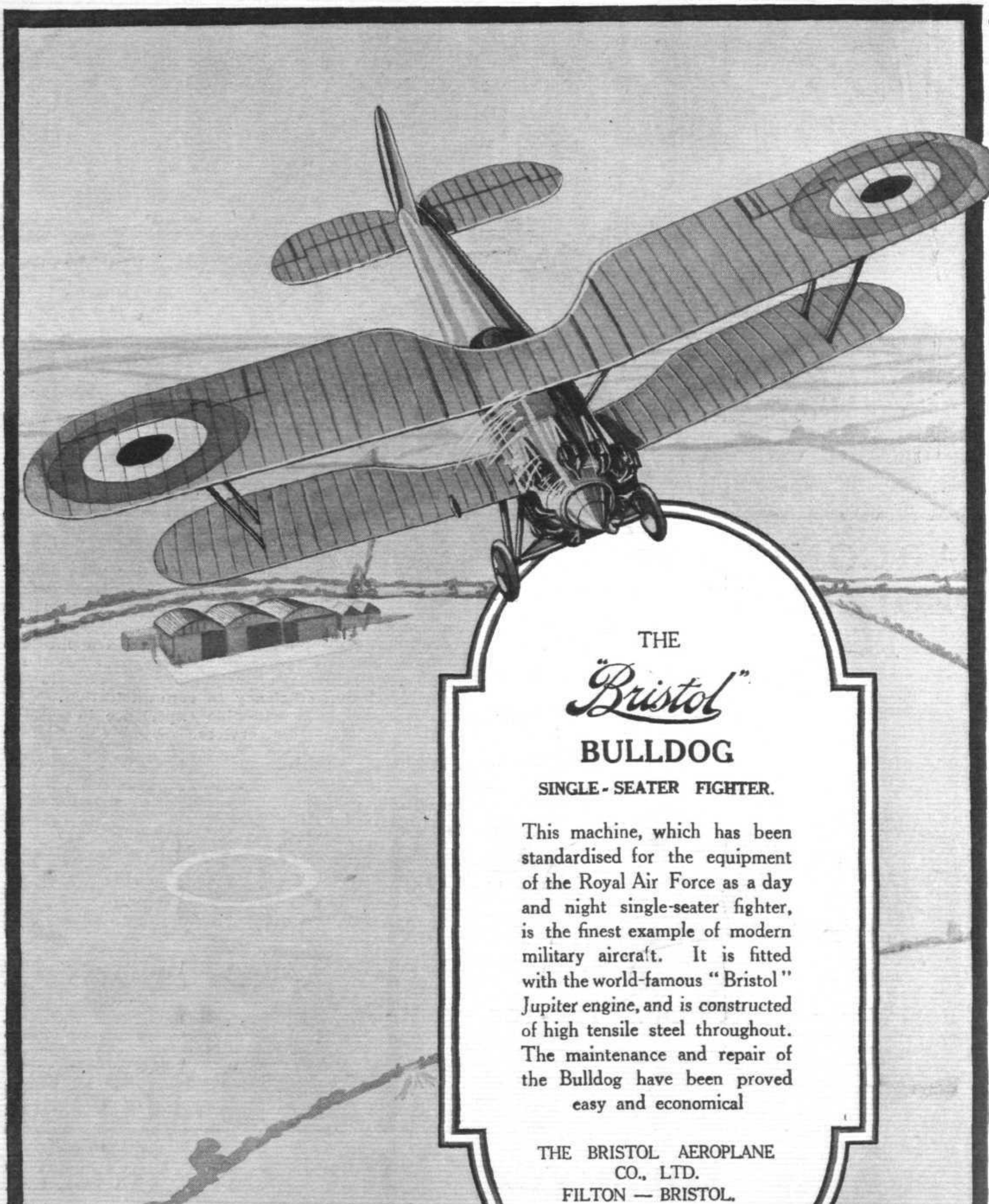
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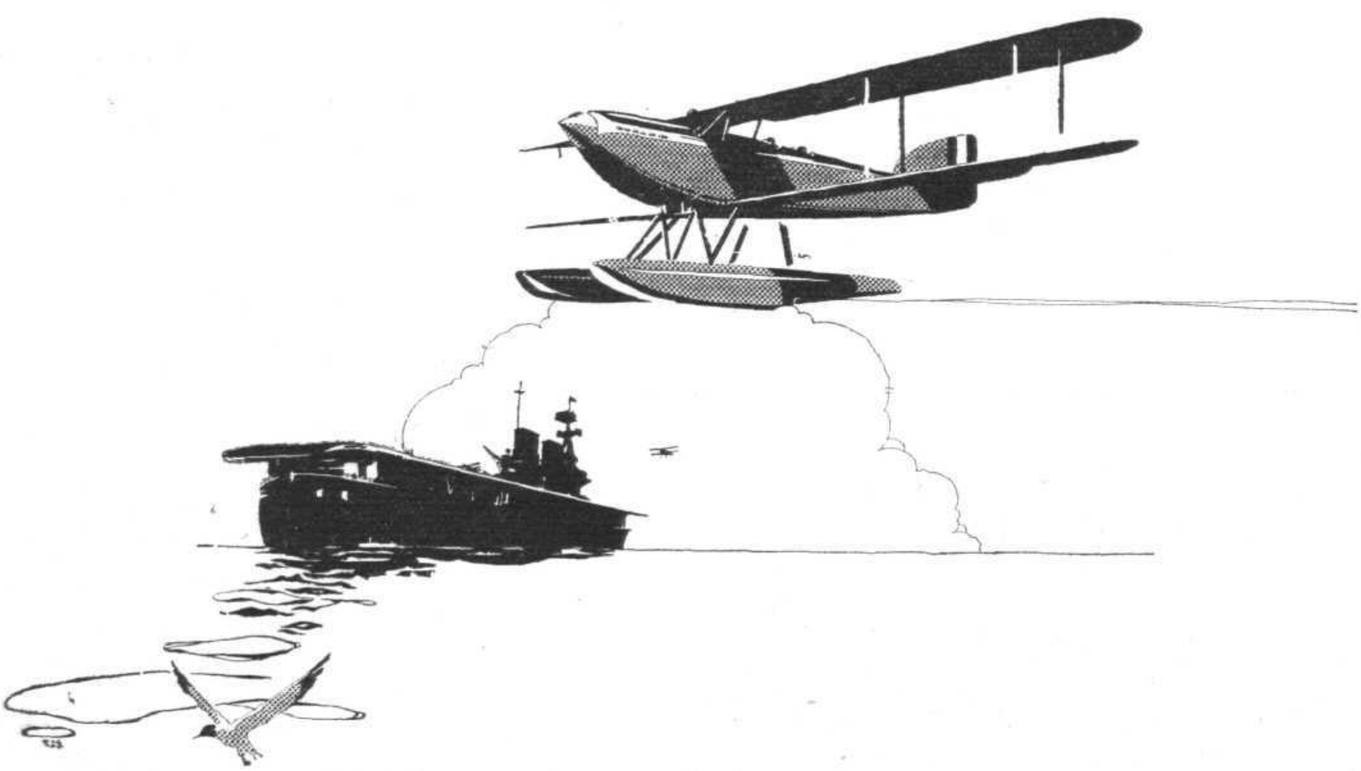

FLIGHT
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Founder and Editor: STANLEY SPOONER

A Journal devoted to the Interests, Practice, and Progress of Aerial Locomotion and Transport

OFFICIAL ORGAN OF THE ROYAL AERO CLUB OF THE UNITED KINGDOM

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CONTENTS

DIARY OF CURRENT AND FORTHCOMING EVENTS

Club Secretaries and others desirous of announcing the dates of important fixtures are invited to send particulars for inclusion in this list—

1929.

Dec. 27 ... **Dinner Dance at Hanworth Club.**

1930

Jan. 1 .... **Film depicting the Flying History of M. Bleriot, at Hanworth Club.**

Jan. 3 .... **Dinner Dance at Hanworth Club.**

Jan. 22 .... **"The Strategical Mobility of Air Forces," Lecture, by Gp.-Capt. C. L. Courtney, before Royal United Service Inst.**

Mar. 5 .... **"Air Co-Operation with Mechanised Forces," Lecture, by Wing-Com. T. L. Leigh-Mallory, before Royal United Service Inst.**

June 28 .... **Royal Air Force Display, Hendon.**

Sept. 6–28 .... **Aero Exhibition, Stockholm, Sweden.**

Nov. .... **Paris Aero Show**

EDITORIAL COMMENT

MARSHAL OF THE ROYAL AIR FORCE SIR HUGH TRENCHARD, Bart, G.C.B., D.S.O., relinquishes the position of Chief of the Air Staff at the end of the year. Admirals of the Fleet, Field Marshals, and Marshals of the Royal Air Force do not retire. They remain officers of their respective services even though unemployed. But the relinquishment of the position of C.A.S. means that in all probability Sir Hugh Trenchard has completed his active career in the Royal Air Force.

The Retiring C.A.S.

The event marks an epoch. "Boom," as he is affectionately called by all pilots, has been practically the creator of the force. The main events of his career were dealt with in these columns in our issue of December 27, 1928, and here it is not necessary to do more than mention the chief facts again. Sir Hugh Trenchard failed to pass into Sandhurst, and entered the army through the militia. His regiment was the Royal Scots Fusiliers. He saw active service in South Africa and Nigeria, and in 1912 he learnt to fly and joined the R.F.C. (Military Wing). When the great war broke out, he was left in charge of the administrative wing at Farnborough. In August, 1915, he took over from General Henderson the command of the R.F.C. in France. Maurice Baring in his book records that on arrival at St. Omer, Gen. Trenchard said to him that "Whatever I might have heard to the contrary, he was not so bad a person to serve under." He was not.

In fact Sir Hugh Trenchard was a great success both as commander of the R.F.C. and the Independent Air Force in the field, and after the war as Chief of the Air Staff. His success may provide a puzzle for psychologists, for it was not achieved by any brilliant qualities of the intellect. Outside his own particular work, he was not an impressive personality. But despite his limitations he nearly always achieved his objects. He achieved them by, first, a sturdy common sense which at times almost amounted to vision; secondly by a very strong will which at times

almost amounted to obstinacy; and, thirdly, by his power of winning the almost passionate worship of the pilots and the aircraftmen. Inside the service he was a demagogue rather than a tyrant. He would, for example, never accept a type of aeroplane as standard equipment until he had learnt what the pilots thought about it. At times his judgment was sounder than theirs. At least on one occasion in France, against his own judgment, he let the pilots of a squadron have their own way in choosing a type of machine, and their way proved wrong.

Sir Hugh Trenchard's work in moulding the Royal Air Force since the war has been more than sound and nearly all of it is destined to endure. In particular, he has given the force a cadet college, two schools of aircraft apprentices, and a staff college. It is as yet scarcely possible to form an estimate of the merits of the staff college, but the other institutions have undoubtedly been most successful. At one time the Chief of the Air Staff was criticised a good deal on the ground of spending too much on bricks and mortar. If a charge had to be made, it should have been the diametrical opposite. The units of the R.A.F. are, for the most part, housed in temporary erections which have the air of a war-time camp rather than of a peace-time station. The R.A.F. is probably the worst housed fighting force in Europe. The army huts have served their purpose, but they will have to go. A beginning has been made by laying the foundations of a permanent building for the cadet college at Cranwell.

The future historian may probably find that Sir Hugh Trenchard's greatest mistake was the institution of short service commissions. It is true that the service has gained not a few of its most brilliant pilots from among the S.S. officers. It is, however, difficult to grasp the mentality of a parent or guardian (other than a millionaire), who would advise his son or ward to accept a short service commission. The recent institution of medium service commissions was in effect an admission that a five years' appointment was not altogether a good business proposition. The question remains: is a ten years' appointment a much better proposition? It may be—if a man is waiting for a rich uncle to die.

These expedients have been the result of clinging to the idea that a pilot must usually be an officer. In the war that was perhaps inevitable, but it is not obvious why it must always be so. The number of airmen pilots has been increased in late years, and it seems inevitable that this movement must spread. The school at Halton is turning out a splendid type of airman, and there is little doubt that it is capable of producing as many sound pilots as may be required. This matter is one of several which will merit the keen attention of Air Chief Marshal Sir John Salmond when he succeeds to the position of Chief of the Air Staff.

DISASTER TO THE CAPE FLIGHT

Both Pilots Killed

A TERRIBLE and unexpected disaster overtook the Fairey (Napier) long distance monoplane which left Cranwell on Tuesday 17th inst., in an endeavour to fly non-stop to Capetown. At 4 p.m. they reported that they were 50 miles off the north-west coast of Sardinia. Up to that point they had averaged a speed of 112 m.p.h., which was well above the necessary minimum average of 86 m.p.h. An Italian report said that they were seen over Cagliari in Sardinia at 5.30 p.m.

Just before midnight on Wednesday, 18th inst., the Air Ministry issued a statement that news had been received of an aeroplane crashing in the mountains to the south of Tunis, and that both airmen had been killed.

Up to the time of going to press, the following facts have emerged. It was calculated that the monoplane would pass over Tunis about 7 p.m., but the watch in the machine was afterwards found to have stopped at 9·40. A sudden storm seems to have broken out as the machine approached the eastern end of the Atlas range of mountains. The machine crashed on a rocky peak in the Zaghwau district, 12 miles from the Arab village of St. Marie du Zit. An Arab horseman named Muhammad ben Ali told a correspondent of the *Daily Mail* that he was making his way over the mountain paths to Zaghwau when he heard the noise of an aeroplane engine, which suddenly stopped. Later by the light of early dawn, he said, he found the wreckage of the machine and pulled the two bodies clear of the debris. He also reported the crash to the French authorities who promptly despatched military patrols into the mountains to find the crash. It was hours before they were able to find it,

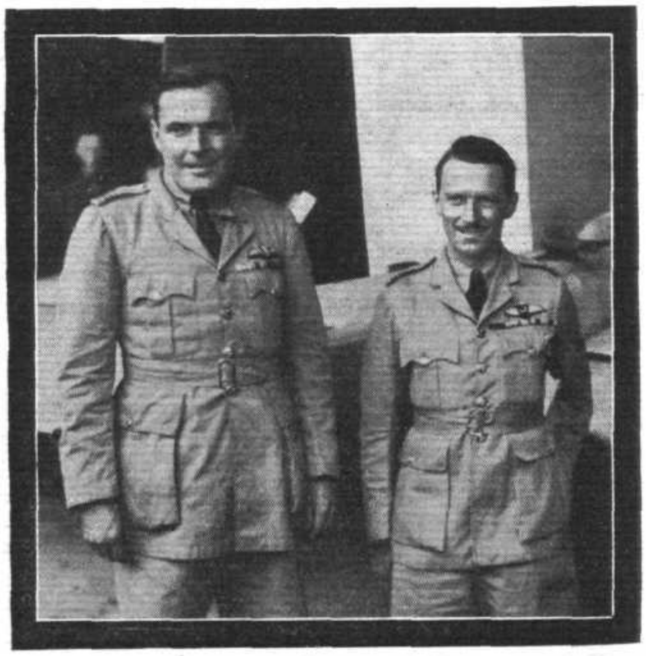
The mountains in this district do not rise above 5,000 ft.

The French authorities in Tunis did everything which was possible. A military aeroplane was despatched to bring the bodies of Squadron-Leader Jones-Williams and Flight-Lieut. Jenkins into Tunis, and full military honours were paid to them. The bodies have been brought to England for burial.

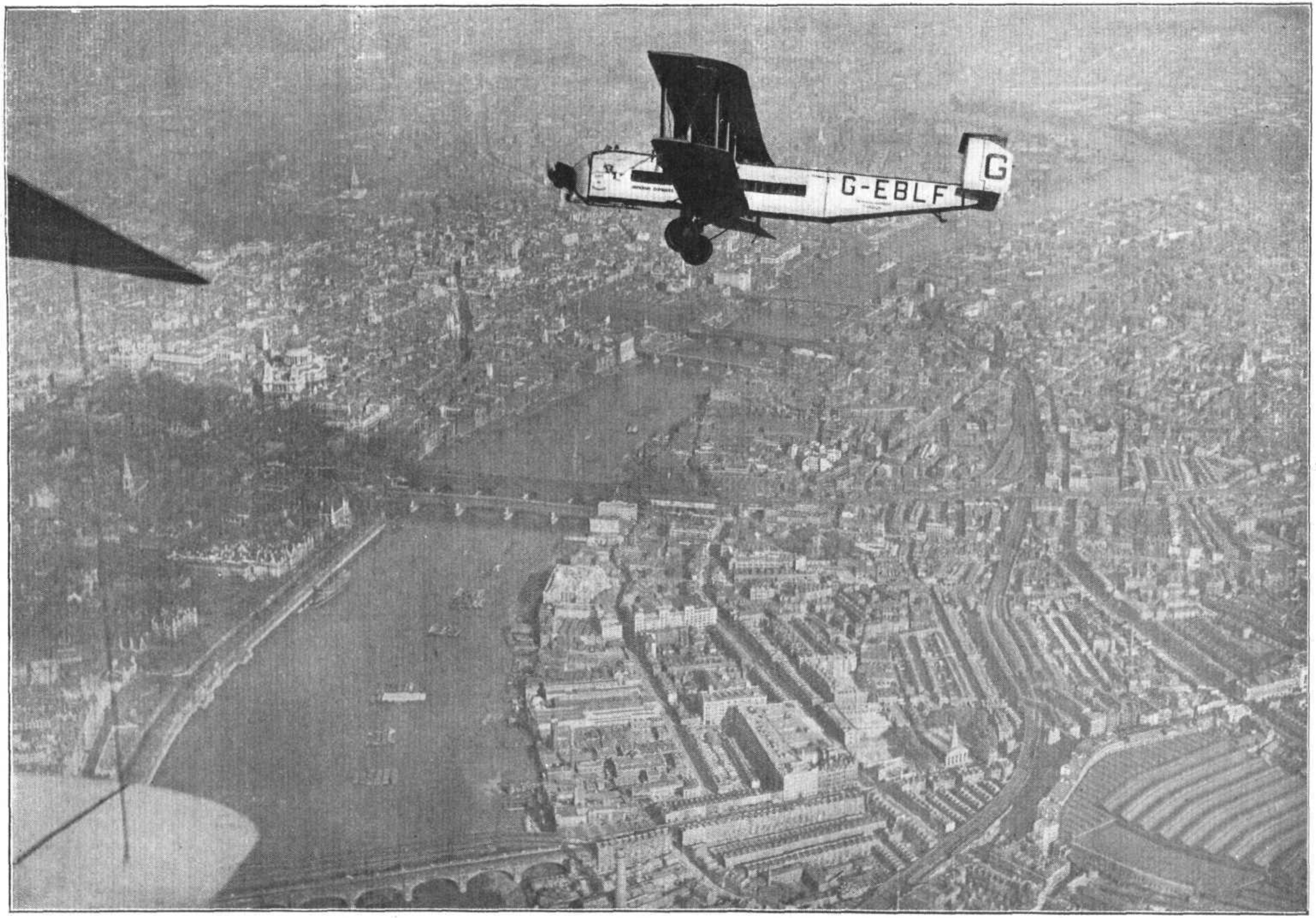
The Air Ministry have despatched to Tunis a technical expert to examine the wreckage, and the Fairey Aviation Co. Ltd., have also despatched a representative. Their reports must be awaited before the cause of the accident can be estimated.

H.M. the King sent the following message to Lord Thomson, Secretary of State for Air:—

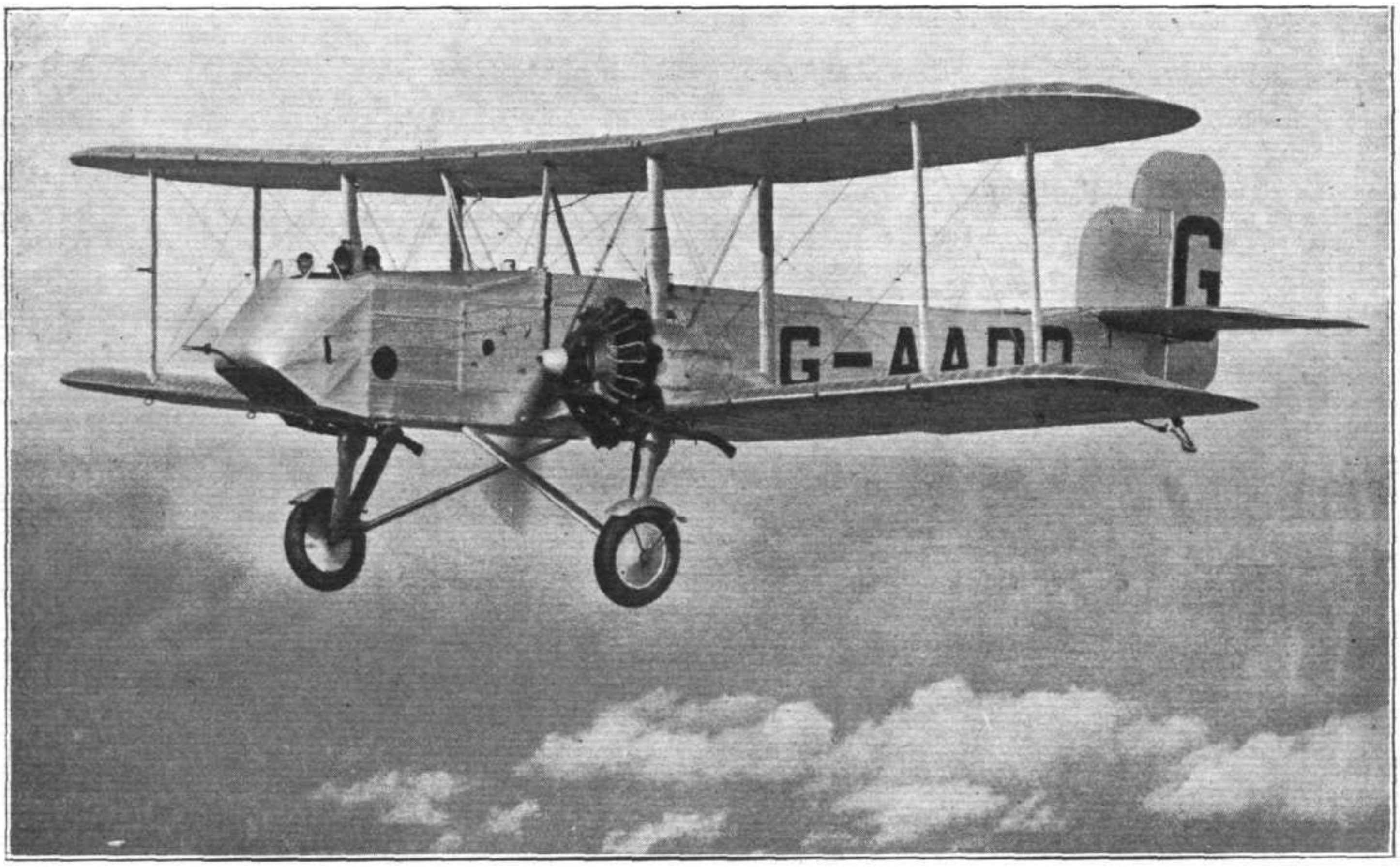
"It is with much regret that I learnt of the disaster to the monoplane near Tunis resulting in the death of the two pilots, Squadron-Leader Jones-Williams and Flight-Lieutenant Jenkins, and I join the Royal Air Force in mourning the loss of two distinguished and gallant officers. Please convey to their families my sincere sympathy."



Squadron-Leader A. G. Jones-Williams, M.C. (left), and Flight-Lieut. N. H. Jenkins, O.B.E., D.F.C., D.S.M.



A REMINISCENCE OF SUMMER: One of the Armstrong Whitworth "Argosy" machines flying over London. The various bridges, with Waterloo in the foreground, are readily identified.



The Gloster A.S.31 (2 Jupiter engines), which bids fair to revolutionise air survey work. Flight *Photo.*

A NEW AIR SURVEY CONTRACT IN NORTHERN RHODESIA

IN our leader of December 13 we announced that a large contract, for a survey in Northern Rhodesia, had been secured by the Aircraft Operating Company, and we pointed out that this was the one branch of aviation which might be truly called commercial and, moreover, was the branch which had shown profits without any form of subsidy, which means that it must be the most healthy business in which aircraft are used.

The effect of the work done by the air survey companies does more, in a short time, to foster the trade of the countries which are surveyed than almost anything else, and therefore it helps in the most direct way in the development of the Empire, and as such should be helped forward by everyone who has it in his power to do so. We have, therefore, very great pleasure in giving this week further details of this survey and the construction of the firm which is carrying it out.

The Aircraft Operating Co., Ltd., have been informed by the Colonial Office that their offer to carry out an air survey of 63,000 square miles of unmapped territory in Northern Rhodesia has been accepted, and the company is also to make air surveys of the following six townships: Nkana, Ndola, Nchanga, Luanshya, Mufulira and Mpika, making a total area of 63,150 square miles.

On July 3, 1929, Mr. J. H. Thomas referred in his speech before the House to Air Surveying, and said that the Goverment were going to have surveys carried out immediately.

The Aircraft Operating Co., Ltd., at that time had recently completed an air survey of some 11,000 square miles of territory in Northern Rhodesia, and had been informed by the authorities that their work was a complete success. The company was also engaged in completing a survey in Iraq of an area of 1,050 square miles adjacent to Baghdad, for irrigation purposes, while a third expedition was engaged in an important air survey of Rio de Janeiro and the Federal District in Brazil, for town planning and development purposes.

Following Mr. Thomas' speech the company immediately put proposals before the Secretary of State for the Colonies for the carrying out of economic surveys of large areas in the Empire. As the result the Governor of Northern Rhodesia requested the company to put forward a modification of their original proposals to meet the present requirements of Northern Rhodesia, and it is these modified proposals which have been accepted. Sir Crawford Maxwell and his Director of Surveys, Mr. Fairweather, are great believers in air surveying, and as the result of his foresight and initiative the Aircraft Operating Co., Ltd., has already completed important air surveys of some 900 miles of the Zambesi River and certain of its tributaries, and also surveys of Livingstone, Mazabuka, Lusaka and Broken Hill, as well as the 11,000 square miles in Rhodesia already referred to.

The new area to be surveyed is bounded on the north by the boundary of the Belgian Congo, and on the west by the Angola boundary. The eastern boundary runs parallel with and to the east of the railway, and the southern boundary is approximately latitude 14° 30′ S., in addition a strip of territory running down the railway is to be covered. The total area is 63,000 square miles.

The area involved consists of rolling country covered by Orchard Bush, among which "dambos" or grassy glades are interspread, and it is considered to contain vast potential riches in copper, where already several successful mines are in operation.

As a first step towards developing this area on economic lines a survey is essential. A survey by ground methods alone would mean that the ground survey department would have to be very considerably enlarged, and even then it would take many years to make, whereas the Aircraft Operating Co., Ltd., has undertaken to complete the work in two years.

Reconnaissance maps on a scale of 1/250,000, that is 4 miles to the inch, will be made from oblique aerial photographs by a special method developed by the company, which is an extension of the oblique method so successfully developed in Canada. These reconnaissance maps will show the topographical features of the country and provide a means of planning road and railway development.

The area will be covered by parallel strips of vertical overlapping photographs taken from 15,000 ft., each strip being 25 miles apart. The prints of these strips will then be taken into the field by the company's ground surveyors. Each survey party will march along the ground covered by a strip using the photographs to find their way. At intervals of approximately 30 miles apart they will select prominent features which show up on the photographs and establish

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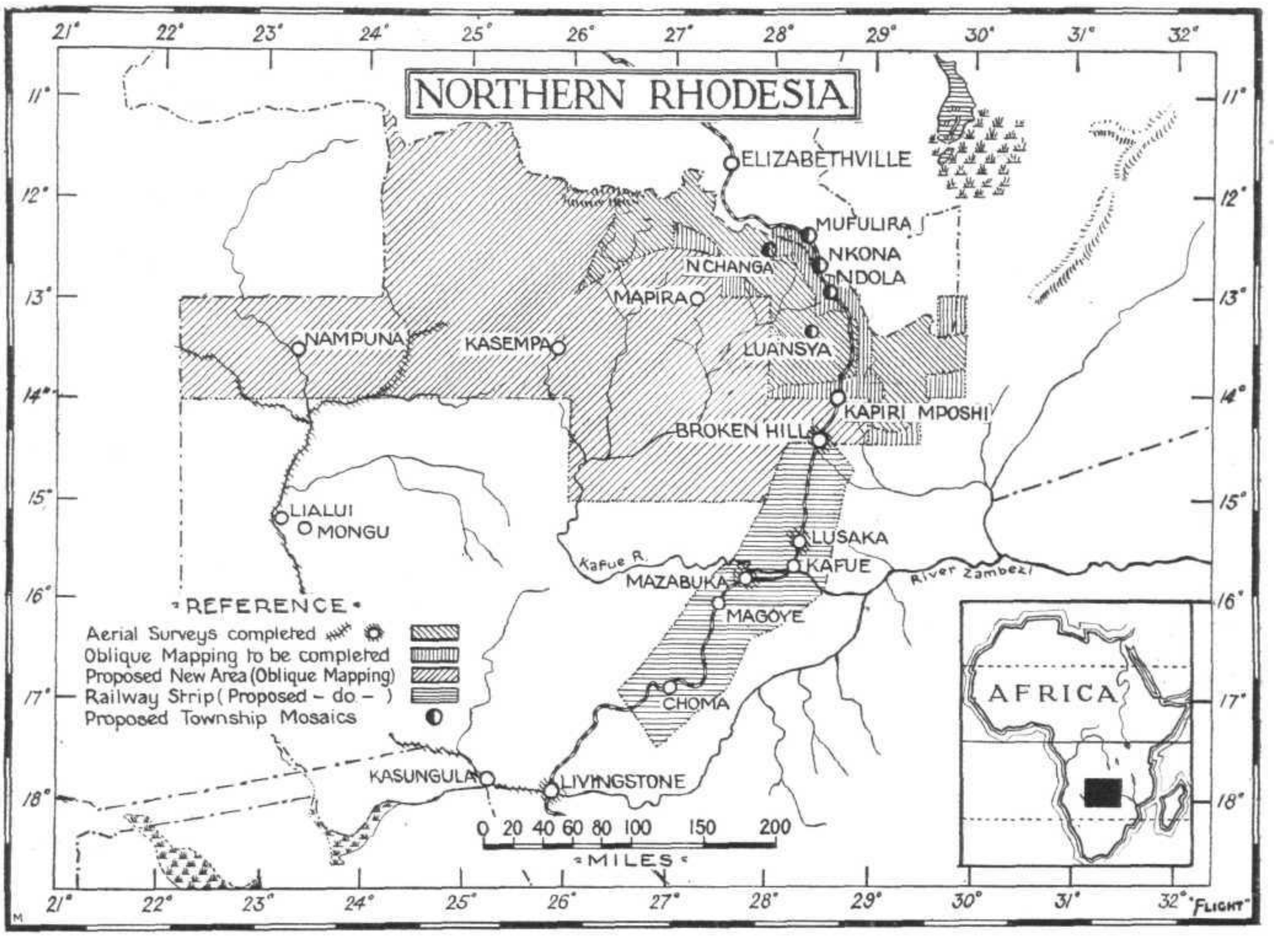
the position of such features by taking astronomical observations and obtaining their wireless time signals by a special wireless set developed for the company by Graham Amplion, Ltd., which was described briefly in Flight on November 1. These strips will form the control strips on which the final maps will be based.

The areas between the strips will be covered by oblique photographs, that is, photographs taken at an angle to the vertical, giving a view similar to that obtained from a mountain top. The final map will then be prepared from the data obtained from the photographs by the aid of a special grid, which is superimposed on the photographs.

This survey with completion in two years, has been made possible through Mr. Alan S. Butler, the Chairman of the company, who authorised the building of a special aeroplane designed for air survey work. This aeroplane has been the camera is one of the most important parts of the equipment of an air survey machine, but they have been developed to such a pitch of perfection and reliability that they are apt to be taken for granted, and their presence rather forgotten when discussing such machines.

In this case two of the cameras are mounted on special mountings called the "Eyrie," which enables the camera to be lowered sufficiently through the floor so that photographs can be secured, without interruption from projections on the machine, in all directions. By having the three cameras thus, vertical and oblique photographs may be taken at the same time if desired.

The pilot sits in the nose of the aeroplane, with the photographer enclosed in a comfortable cabin behind him. This arrangement gives such good visibility that the work is considerably speeded up. It is estimated that by using



designed and built by the Gloster Aircraft Company, and was described in Flight of July 11. It cost some £15,000 to build, but Mr. Butler's faith in the future of air survey was so great that he decided that the risk was worth taking. The securing of this important new contract has more than justified the construction of this special machine, for without a machine of this type the survey could not be made.

The air survey machine is unique among aircraft. Although it is only necessary to carry a pilot and photographer, together with camera gear, the machine has two Bristol Jupiter engines, developing together some 1,000 h.p. The special design and large reserve of power enables the machine to climb to 10,000 ft. on one engine. With two engines the machine can carry out aerial photography at 21,000 ft. (6,408 m.). This means that vast inaccessible areas can be surveyed with the maximum of safety, as the reserve of power enables the machine to be flown at a low throttle setting, and in the case of one engine's failing the machine can fly comfortably on the other engine without having to use full throttle.

The machine is fitted with aircraft cameras of a very special design, which enable it to be used for this work. The "Eagle," made by the Williamson Manufacturing Co. of Willesden Green, is the camera used, and the machine is fitted with three of them. It will readily be realised that this aeroplane 30,000 square miles of country can be photographed from a single landing ground. It will thus be seen that a considerable advance has been made since the time when the company carried out its first survey in Africa for the Rhodesian Congo Border Concession, Ltd. In that survey the company were provided with landing grounds in the bush every 20 miles, *i.e.*, one landing ground to every 400 square miles.

It is interesting to note that in connection with this previous survey no forced landings took place in the areas in which the landing grounds had been prepared. Single engined aeroplanes were used, and when a reconnaissance of an area which was almost unexplored, and in which there was no landing ground, was suggested, the pilots, geologists and photographers offered to take the risk of making the reconnaissance. Two machines were sent, one carrying the geologist, the other the photographers. One of them had trouble and was forced down in the heart of the lion country. The pilot had almost effected a safe landing in a "dambo" when his machine was wrecked by an ant hill. The crew had to walk 75 miles to the nearest European outpost. This incident largely contributed to Mr. Alan Butler's decision to have a special air survey aeroplane, built so as to make the surveying of inaccessible areas, such as the company has to contend with in Africa and

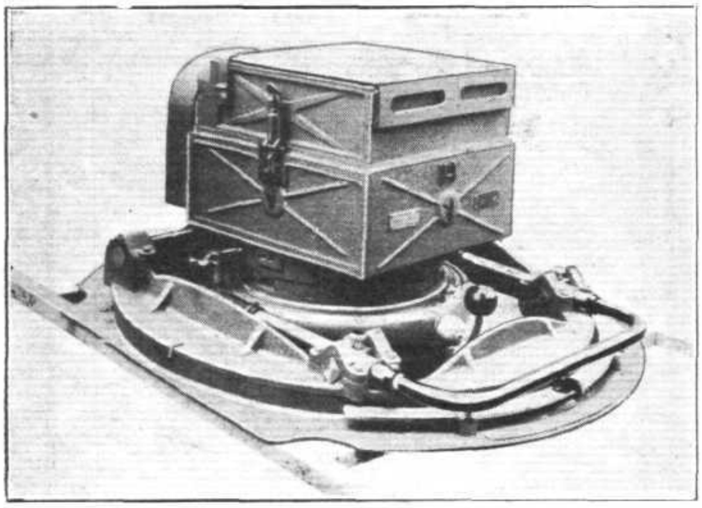
South America, as safe as possible. The following are the official performance figures :—

Weight, 8,500 lbs., including 240 gallons of fuel, 31 gallons of oil, and 460 lbs. survey loads.

Height Ft.	Max. Speed M.p.h.	Rate of Climb Ft./min.	Time to Height Min.
0	139·0	1,840	—
5,000	138·5	1,420	3·2
10,000	135·0	1,040	7·4
15,000	128·5	650	14·2
19,000	120·0	320	22·7

Service ceiling, 21,900 ft.
Absolute ceiling, 23,200 ft.
Ceiling, with one engine at 8,500 lbs., 10,000 ft.
Stalling speed, 44 m.p.h.
Maximum permissible flying weight, 9,000 lbs.

The Aircraft Operating Co., Ltd., is among the first



The Eagle Camera arranged for vertical photography

companies to receive work as the result of the Colonial Development Loan Bill, which recently passed the House, and is certainly the first aviation company to benefit. Mr. Thomas, in searching for ways and means of finding employment, realised the necessity of developing the Empire. It is now recognised that development of undeveloped areas cannot take place until a survey has been made. The offer that the Aircraft Operating Co., Ltd., put forward is one which strongly appealed to Mr. Thomas as a means of quickly developing our Colonial resources, and thus helping unemployment. These reasons must also have been apparent to the Special Committee appointed to examine and report on schemes submitted in connection with the Colonial Development Bill. The Committee, after examining the company's proposals recommend the Treasury's approval, which has now been given.

It is customary to believe that commercial aviation has been developed largely by subsidies at the expense of the tax payer. While this is true to a great extent, it should be remembered that air surveying has been entirely developed by private enterprise, and has never received any form of direct or indirect subsidy. In addition to becoming self-supporting, it is able to make a very valuable contribution towards the solution of the unemployment problem. Vast areas can be surveyed from the air in a fraction of the time that it takes on the ground. The resulting photographs provide priceless data relating to the economic resources of the country, in addition to the data required for mapping purposes, within a few months of starting the survey ; so that development schemes can be put in hand quickly. The survey of a potentially rich area is bound to be followed by the building of railways and roads, the development of town sites, water power and light, agriculture and all the other branches of civilization. This means that the call for employment in the development of the country should be considerable, while the call for all the materials required in connection with this development should provide work for thousands in this country.

Immediately after the war, Majors H. Hemming, A.F.C. and H. H. Kitchener formed the Bermuda and West Atlantic Co., Ltd., starting with pleasure flying in Bermuda. This company quickly grew and sent out the first air survey expedition from England. The expedition was under the leadership of Major Cochrane-Patrick, D.S.O., M.C., and carried out an air survey of the Orinoco Delta in Venezuela and of Georgetown, British Guiana. While the value of the early work carried out by the company has been recognized by the authorities, it was, however, forced to close down as the result of the slump following the post-war boom. Just prior to closing down the company put forward proposals and estimates for an air survey of the Irrawaddy Delta in Burma. Mr. R. Kemp, who had previously been Aeronautical Adviser to the Government of India finally secured the contract. Major Cochrane-Patrick joined Mr. Kemp and carried out the flying and technical supervision of the survey, while Major Hemming joined a company operating in Newfoundland under the chairmanship of Mr. Alan S. Butler, in order to start the air survey section for Mr. Butler's company. After carrying out aerial photography in Newfoundland and Labrador, Mr. Butler decided to suspend operations owing to the difficulty of securing contracts. Mr. Butler and Major Hemming then formed the Aircraft Operating Co., Ltd., in this country on January 30, 1923. At the start, the company consisted of three directors, Messrs. A. S. Butler, chairman ; H. Hemming, managing director, and T. P. Mills. The only other members were a secretary and a typist. To-day, some six years later, the company has 150 members on its staff consisting of many nationalities, and its personnel has carried out air surveys in Europe, Asia, Africa, and North and South America. After returning from the position of superintendent to the survey of India, Col. H. L. Crosthwait, C.I.E., R.E. (Retd.) joined the board, in order to assist and advise the company on ground survey matters. Major Cochran-Patrick, D.S.O., M.C., became the director responsible for the air survey operations, and Major R. H. Mayo developed a consulting branch, and in the capacity of a director advised the company on technical matters.

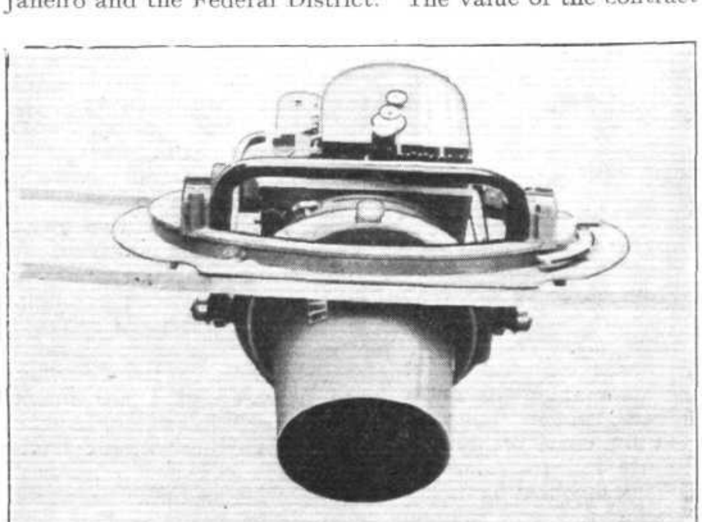
To-day, the Aircraft Operating Co., Ltd., thanks to its chairman, who has entirely financed its operations, can claim to be the leading air survey company in the world. It has already completed work in different lands to the value of £133,340 ; it has a further £109,304 of work in hand, and £215,000 representing the value of work on offer.

One of the greatest difficulties with which the company has had to contend has been the securing of competent personnel. To meet this difficulty the company established its headquarters, drawing offices and laboratories at Hendon, where it is training young men from the universities to become qualified air surveyors.

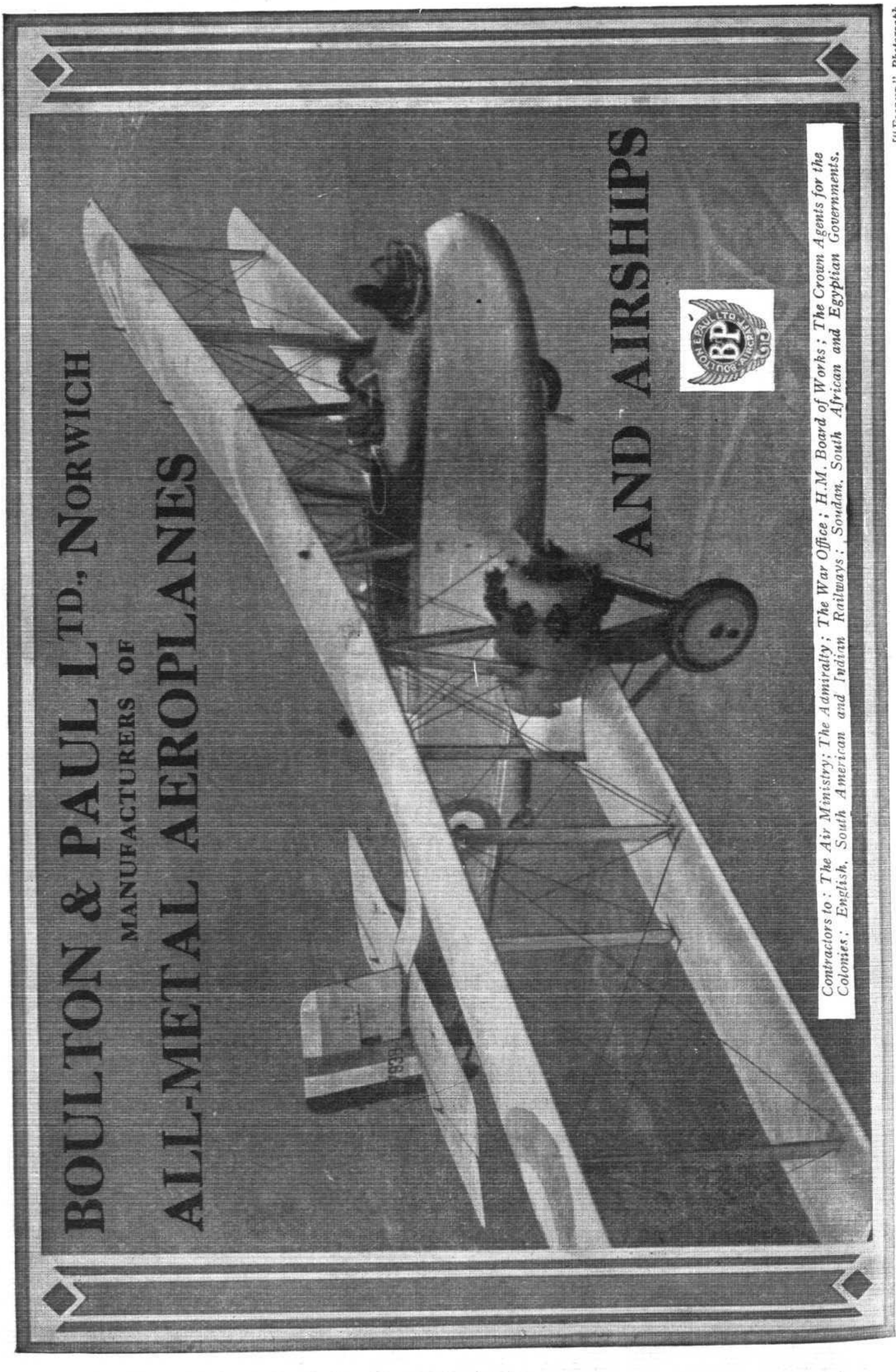
The headquarters of the African Expedition are situated at Bulawayo, Southern Rhodesia, where Capt. Garth Trace is in charge. A steel hangar has been built on the racecourse, and fully-equipped photographic laboratories and drawing offices erected.

The South American expedition has its headquarters at Rio de Janeiro, the capital of Brazil. Mr. Hemming, the Managing Director of the company, has recently returned from Brazil having handed over the command of the expedition to Mr. Wavell, who was previously in the Colonial Survey Service.

The company's Brazilian expedition has very well-equipped laboratories and drawing offices in the heart of Rio, and are at present engaged in completing the survey of Rio de Janeiro and the Federal District. The value of the contract



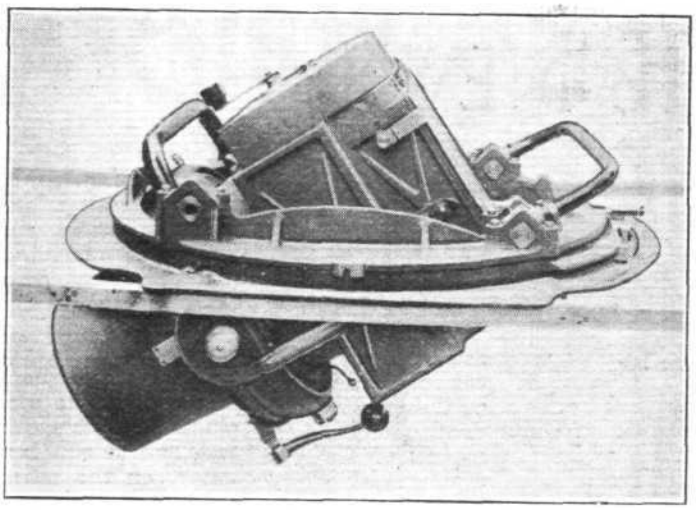
The Eagle Camera on the Eyrie mounting ready for oblique photography—front view



["Flight" Photograph.

was £125,000, and represents the biggest air survey contract in value ever secured.

The Brazilian expedition is quite an international organiza-



The Eagle Camera and Eyrie mounting—side view

tion. The home section consists of staff sent out from England, the local section, in addition to its Brazilian members, includes citizens of Germany, Austria and Russia, the whole staff combining most happily and efficiently in the carrying out of the survey. As the result of the success of the work carried out to date, the Brazilian expedition has secured several more contracts, and has now moved its air unit to Sao Paulo, in order to carry out work there.

As the result of its experience to date, it has been impressed upon the directors that the aerial photographs contain so much comprehensive information relating to forestry, geology, and general economic development, that they are arranging to employ experts who specialize in these various branches.

A great deal of valuable research work has been carried out by the company, in co-operation with Mr. R. Bourne, lecturer at the Imperial Forestry Institute, Oxford, who found that he could recognise the different types of vegetation in the photographs, and so gain valuable indications as to the geology of the country. The photographs that the company has taken for him clearly show, in many areas, the geological boundaries, and make an interesting comparison with the geological map of Great Britain.

Capt. C. R. Robbins, M.C., has recently retired from the Indian Forestry Department and joined the company. He carried out the interpretation of the aerial photographs on the Irrawaddy Survey, and is also a recognised expert in compiling forestry maps by sketching from the air. There is an enormous field of development for air survey, as applied to forestry work.

It will thus be seen that, starting from humble beginnings, the Aircraft Operating Co., Ltd., is collecting together a staff of experts trained in all branches of development work. It is proposed to circulate the key members of the staff among the different expeditions, in order that the work may be co-ordinated. The company now has under consideration the formation of associated companies in different parts of the world, with a view to each branch being run on lines best suited to local conditions. The technical management of all these companies will be controlled by the Aircraft Operating Co., Ltd., in London, through local directors. The London office will collect data from the various expeditions and distribute it, thus ensuring that full advantage is taken of latest experience, and that the experiences learnt in one part of the world are available to other parts.

By providing an organization of this sort, the company will be able to carry out surveys for Government departments far more rapidly and cheaply than those departments could do it themselves. It would not pay a Government department to carry out air survey work because the surveys are completed so rapidly that, on completion, the large staff required would be idle. This would mean that there would be large overhead expenses. The Aircraft Operating Co., Ltd., is able to carry out the work cheaply, as it can spread its overhead expenses over all its fields of operation.

The term air surveying is misleading. It gives the impression that surveys are made entirely by air methods. This is not correct. All surveys depend for their accuracy on a ground control to be provided by the ground surveyors. The aeroplane and the air camera enable the ground surveyors to speed up their work and extend their work to areas which had previously been inaccessible to them. The Aircraft Operating Co., Ltd., has a large number of ground surveyors on its staff.

Then there is the question of cost. Cost depends entirely on the scale of the final map required, the nature of the country and the type of information to be included. Flat country is far cheaper to survey than hilly country. Open plain is cheaper than jungle. Costs, therefore, vary enormously. To take two extremes, the large-scale survey that the company is making of the centre of Rio de Janeiro costs about £2,500 per square mile. This is due to the large scale of 63 in. to the mile, and the immense amount of detail required. That means that door steps which extend beyond the ground line of the houses are shown. On this scale there have to be a large number of control points to each square mile. In work of this nature, most of the survey is undertaken on the ground, but the work is immensely speeded up by using the aerial photographs which enable the interior detail of the blocks of buildings in a city to be put in, thus saving enormous labour on the ground. In an area of 4 square miles in the centre of Rio, 150,000 buildings are being mapped at a cost of £2,500 per square mile, in less than 2 years.

To go to the other extreme, in Northern Rhodesia the company completed a survey of 11,000 square miles at a cost of approximately £2 15*s*. per square mile. The map was on a scale of 4 miles to the inch. Instead of having a large number of control points per square mile, control points were from 30 to 40 miles apart, that is, one control point on an average to every 900 square miles, and contours were not required. This means that very little work is required on the ground and accounts for the enormous difference in price. It will thus be seen that it is not possible to quote standard prices for air survey work. Each contract has to be specially quoted for. In some cases the local survey department may wish to supply the ground control and print the maps. In other cases the contractor has to do the whole operation, as the company are doing in Rio and Rhodesia.

Perhaps one of the greatest handicaps that the air surveyor has to contend with is the fact that his claims are so revolutionary in character that many people will not consider them seriously.

Abundant proof is now available from air surveys that have been carried out in different parts of the world as to the advantages that are claimed for this new science.

All those who are concerned with development work, be they governments, borough councils, railway, mining or engineering companies, should consult the air surveyor in connection with the problems relating to their work. An air survey enables detail on the ground to be seen in perspective when the photographs are examined in the stereoscope. Insurance companies can study fire risks by seeing, for example, the presence or otherwise of temporary wooden buildings in the yards in the centre of blocks of buildings.

The railway engineer can plan the general direction for his grading party. The timber owner can value his timber and judge the ways and means of working it. The electrical engineer can select positions for power sites, and study "Way leaves" for power lines without having to go over the ground in the first instance. Aerial photography has its application in every branch of development.

Aerofilms, Ltd., a subsidiary company of the Aircraft Operating Co., Ltd., specialises in aerial photography in the British Isles. Among the several important contracts that they have carried out is an air survey of Central London. The resulting map was exhibited in all the tube railways. A contract was carried out for the London Police to enable traffic conditions to be studied. A great deal of work has been undertaken for borough councils and surveyors in connection with housing schemes.

It will be seen, therefore, that this new science has come to stay. It is still in its infancy, and a strong bid is being made by foreign countries to gain the lead in this important work. Great Britain has the lead so far. We are up against subsidised foreign competition, but at present we are a long way ahead in the practical field. In order that work may be carried out cheaply big contracts are required. While it is true that the equipment and personnel are costly, the out-turn of work is very cheap, provided the areas surveyed are large.

There is an enormous field awaiting the air surveyor and it is hoped that the lead which the present government has given by recognising the value of air survey work, will result in further big contracts being secured all over the world by British interests.

PRIVATE FLYING AND CLUB NEWS

AN AMPHIBIAN OWNER FROM FRANCE

Baron de Precourt.

AN aspect of private flying which has not developed to any great extent in England is the use of seaplanes and amphibians. Sqd.-Ldr. Hinkler hopes shortly to remedy the deficiency which, up to the present, has precluded the general use of small amphibians, and his Ibis may very well be the means of starting a movement which will be as far reaching as that which was virtually brought about by the introduction of the original Cirrus-Moth.

To those who have flown to any great extent, there have always come times when they have wished that they might alight on convenient quiet stretches of water, stretches which are often inland and pleasantly secluded away from the madding throng, and where there is no possibility of landing on the ground and to such as these, who may spend many hours in touring or travelling, the light amphibian should prove a godsend.

There are, of course, many disadvantages which must be overcome before this type becomes popular, such as inherent difficulty of handling both in the air and on the land, smaller pay load for a given size of engine and machine, and lastly, the initial cost, but none of these should prove insuperable if some designer were to really get down to the task of supplying this very definite market. Up to the present, all light aircraft have been built to supply the needs of both the paterfamilias and the sportsman who scorns goggles and sometimes wishes to do a bit of racing, and they have been admittedly compromises, but the time is rapidly coming when prospective buyers will no longer accept compromises, and just as in the car market, the compromise in the shape of the open car is dying a slow but sure death, and is being replaced by pure sports models on the one hand, and saloon cars replete with every comfort on the other, so will cabin aircraft take the place of the open cockpit machine for those who do not wish to do other than tour in comfort, while the open cockpit machine will remain, in a cleaned-up form, for the sports model.

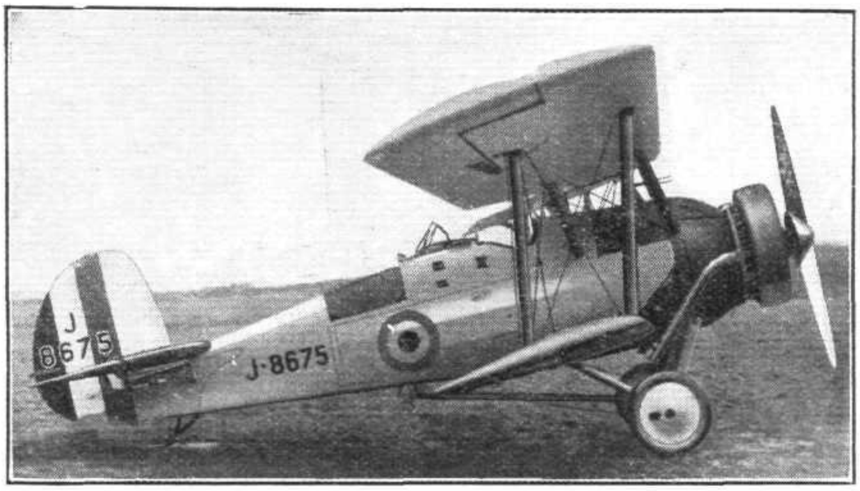
However, the analogy is somewhat complicated by the undoubted fact that the cabin machine will certainly eventually have an amphibian undercarriage as a matter of course, and will thus open up a far wider field for the potential private-owner to extend his tours in safety.

The advantages of seaplane travel are probably not to be obtained in such a decisive fashion, in England, as they are in, say, Canada, but even here there is little doubt that the general use of amphibians would materially add to the pleasure which our private owners obtain from their machines.

In the Mediterranean, this applies to a far greater extent, and given fine weather, there can be few finer fields for seaplane travel. This week we show some photographs of the machines used by Baron de Precourt, who is a keen

Le Baron et Madame La Baronne in their Schreck flying boat returning from Corsica.

ARMSTRONG WHITWORTH
AIRCRAFT



THE ALL-STEEL ATLAS

(ON WHEELS, FLOATS OR SKIS)

THE all-steel Atlas is the best aircraft for land or sea reconnaissance.

It is the standard Army Co-operation two-seater of the Royal Air Force.

Its steel construction accounts for its unrivalled durability and ease of maintenance. Fitted with the world-famous Armstrong Siddeley Jaguar engine (plain or geared type), its speed, climb and ceiling fulfil the severest Service requirements. It is produced on the grand scale by the best equipped aircraft works in Europe.

PERFORMANCE FIGURES

ATLAS WITH JAGUAR ENGINE AND TOWNEND RING

Fuel, 75 gallons (337 litres). Oil, 7 gallons (32 litres). Military Load, 880 lbs. (400 kgs.)

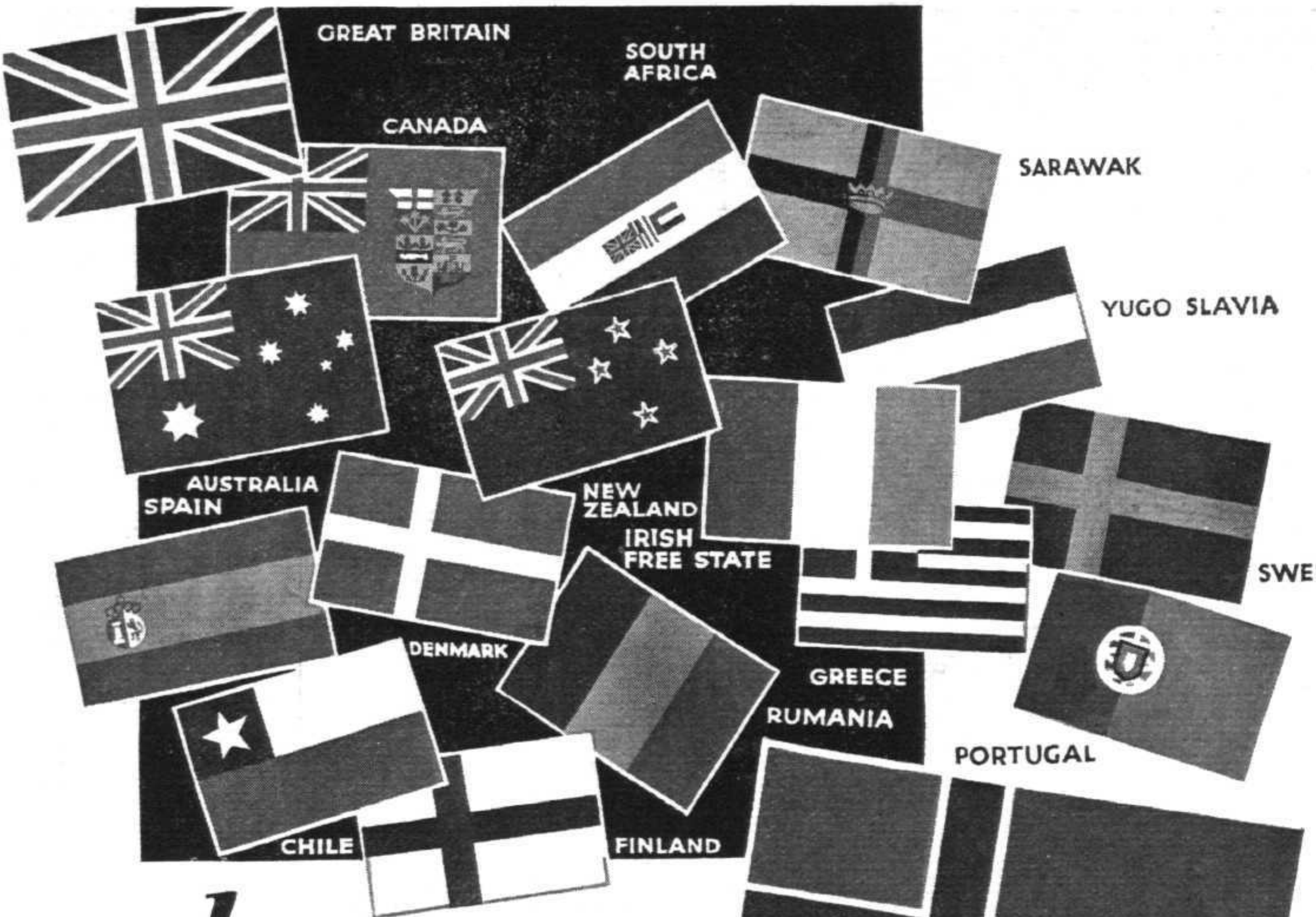
	Plain Engine.	Geared Engine
Approx. total weight	4000 lbs.	4115 lbs.
	1820 kgs.	1870 kgs.
Speed at ground level	143.5 m.p.h.	149 m.p.h.
	231 km.p.h.	240 km.p.h.
„ „ 5000 ft.	139.5 m.p.h.	145 m.p.h.
„ „ 10000 ft.	134 m.p.h.	140 m.p.h.
„ „ 15000 ft.	125 m.p.h.	131 m.p.h.
„ „ 1000 metres	226 km.p.h.	236 km.p.h.
„ „ 3000 metres	216 km.p.h.	225 km.p.h.
„ „ 5000 metres	193 km.p.h.	204 km.p.h.

	Plain Engine.	Geared Engine.
Time to 5000 ft.	5.25 minutes	4.25 minutes
„ „ 10000 ft.	12.5 „	10.5 „
„ „ 15000 ft.	26 „	21.75 „
„ „ 1000 mtrs.	3.5 „	2.5 „
„ „ 3000 „	12.5 „	10.25 „
„ „ 5000 „	34 „	27.5 „
Absolute Ceiling	19000 ft.	19100 ft.
	5800 metres	5830 metres
Service Ceiling	17300 ft.	17700 ft.
	5280 metres	5400 metres

Maximum allowable R.P.M. 2200. Normal R.P.M. 2000

SIR W. G. ARMSTRONG WHITWORTH AIRCRAFT LIMITED

Works and Aerodrome: Whitley, Coventry. London: 10 Old Bond Street, W.1

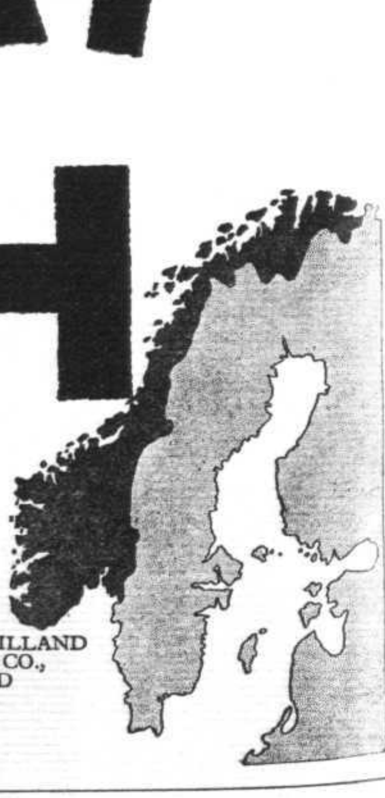


and now...

NORWAY

chooses

MOTH



FOR SERVICE TRAINING AND OTHER OFFICIAL DUTIES

By her decision to equip the Norwegian Ministry of Defence with Gipsy Moths, Norway brings the total of Dominion and Foreign Powers who have selected the same equipment for Service purposes up to no less than seventeen.

THE DE HAVILLAND AIRCRAFT CO., LIMITED
Stag Lane Aerodrome
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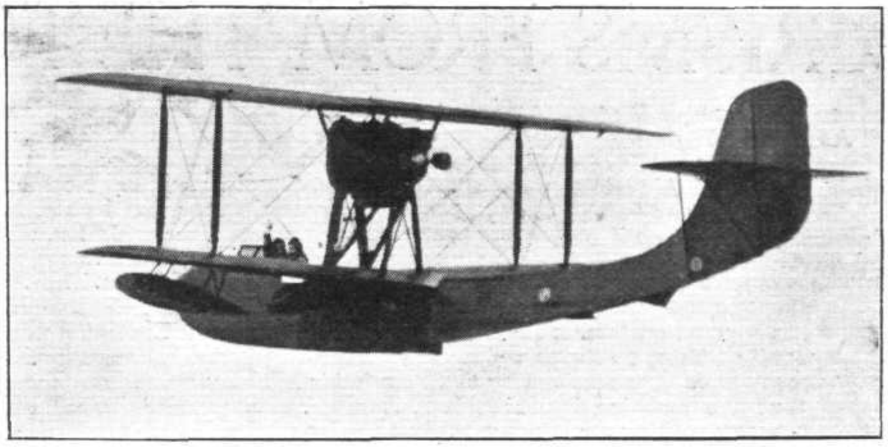
Telegrams: Havilland-Phone-Edgware
Telephone: Edgware 0171

THE DE HAVILLAND AIRCRAFT PTY. LIMITED
Whiteman Street, South Melbourne, Australia
Telegrams: Moth, Melbourne

THE DE HAVILLAND AIRCRAFT OF CANADA, LIMITED
Sterling Tower
372 Bay Street, Toronto 2
Canada
Telegrams: Moth, Toronto

THE DE HAVILLAND AIRCRAFT CO., LIMITED
Karachi
India



The amphibian Schreck at La Baule.

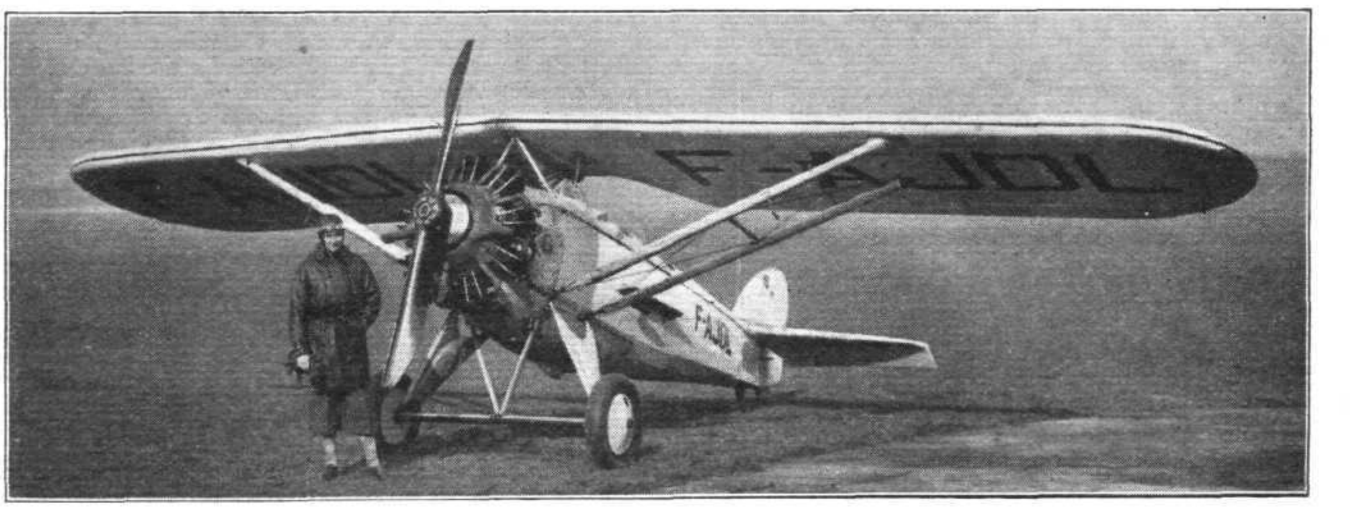
private owner, and who has done an immense amount to spread the gospel of air-mindedness in France.

The Baron, who, even at this early stage in his flying career is already a popular figure in flying circles, only got his pilot's licence in July, 1928, and immediately after doing so, he bought a Schreck flying-boat. Within a very short time, he and his wife were touring in the Mediterranean, and that year they made a round trip from Antibes, round Corsica to Naples, then via Ostia and Pisa back to Antibes.

He says that he has found the conditions ideal in the spring and summer and almost every little bay provides adequate landing for his Schreck. So much so that he bought a property at Pampelone near St. Tropez and had suitable hangars erected.

Last year he realised the forceful argument in favour of the amphibian and when he returned to Pampelone he took with him an amphibian Schreck. An added advantage which he has found in this type of machine is the ability to lower his wheels when in the water and so taxi straight out and up to his hangar.

Later he took part in the Rallye at La Baule and secured first place in his Schreck amphibian by making the trip Marseille, Perpignan, Toulouse, Bayonne, Angers, and La Baule, a distance of 1,180 kms. (733 m.) with five landings between 5.45 a.m. and 5.55 p.m.



The Baron with his Morane 130. (Salmson 230 h.p. engine.)

Of this particular occasion he says that the views of the Pyrenees from Perpignan to Bayonne were wonderful, while from Bayonne to Hourtin the deserted "Landes" offered a great attraction to those who take a delight in hedge-hopping or rather, "sand-dune hopping."

More recently he acquired a Morane 130 with a Salmson 230-h.p. engine at Villacoublay. This machine he found very fascinating and on applying to pass a course for his military licence was sent to Dijon, where he arrived rather to the surprise of the instructors, complete with his own machine.

The Baron's hangar at Pampelone has apparently become well known as an agreeable meeting place by pilots of the French Navy and others and he very sportingly invites any English pilots flying in the district to pay him a visit.

For the coming spring he has planned to take a party of friends, who have also bought similar Morane machines on a tour of Europe but for all tours in which he is, so to speak, just touring without a hard and fast itinerary he uses his Schreck Amphibian.

With the exception of the Hinkler Ibis the only light amphibian machine that has recently been produced for private owners in this country is, as far as we know, the Short Amphibian undercarriage which was fitted to Mr. Scott-Taggarts Moth. This machine is not, of course, in quite the same class as the Schreck, as it is a normal type Moth with a combined float and wheel undercarriage, but it is definitely a step in the right direction, and we hope that before this year is very old we shall hear of at least, the Ibis, if not other machines of this type being used in increasing quantities by private owners.

THE READING AERO CLUB (which has been formed from the pupils of Messrs. Phillips & Powis School of Flying), held their first dance at the Cadena Cafe, Reading, on December 11.

Between 90 and 100 guests were present, and spent a most enjoyable evening.

The competitions were connected with makes of aeroplanes and registration numbers, and some attractive prizes, including free flying lessons, were presented. Two novelty dances were held, a Cinderella Dance and an Excuse-Me Dance. In the latter model aeroplanes were used instead of the usual spoons.

Altogether the dance was a great success. Many thanks are due to the organisers, especially Mrs. Powis.

TWO British-built Gipsy-Moths were first and second in the first air race ever held in Mexico, on December 12. The contest took the form of a 30 miles' sprint, starting and finishing at Mexico City.

THE ARMY AND NAVY CO-OPERATIVE SOCIETY, LIMITED, wished to include a complete Gipsy Moth in their Christmas display at their main premises in Victoria Street, S.W.

Accordingly, the De Havilland Aircraft Co., Ltd., readily loaned them a Gipsy-Moth "on sale or return." Hardly had the Moth been delivered and placed on show than Sir Hugh Clifford, who is learning to fly, saw it and purchased the machine.

AIRISMS FROM THE FOUR WINDS

France Encourages Record Attempts

As an encouragement to French airmen at their attempts to capture the world's long-distance record in a closed circuit, the French Air Ministry has allotted a fixed bonus of 500,000 francs (about £4,000) to any airman who succeeds in the attempt, plus a sum in proportion to the distance covered. The airmen Costes and Codos, who now hold this record, will consequently share between them the bonus of 500,000 francs, plus 360,000 francs (nearly £3,000) in respect of the 5,052 miles covered on their flight.

The Lassalle Flight to Saigon

Reports have been received by the French Air Ministry stating that the machine in which MM. Lassalle, Rebard and Faltot were making an attempt to fly to Saigon passed over the Tripolitan frontier on the morning of December 15, the day the airmen left Tunis. As they were not reported from Tripoli it is assumed that they have made a forced landing in the intervening territory, and search parties have been sent out.

The Le Brix Flight to Saigon

Capt. Le Brix and Capt. Rossi landed at Bamrauli Aerodrome, Allahabad, on Saturday, December 21. The flight would appear to be delayed now, owing to a defect which necessitates spare parts being obtained. These have been wired for from Paris.

Sir Alan Cobham's Progress

Sir Alan landed at Helipolis on December 19, and arrived at Khartoum on December 21.

The Search for Lieut. Eielson

A new attempt to find the Arctic airman, Lieut. Carl B. Eielson, who, together with a mechanic, Mr. Earl Borland, has been lost near North Cape, Siberia, since November 9, has failed owing to bad weather. Further efforts are to be made. Many of the airmen at Teller, old colleagues of Lieut. Eielson, still believe that he and Mr. Borland are alive, and probably trekking across the snow towards the fur ship Nanuk, which is fast in the ice.

Another Australian Flight in Progress

Much secrecy has shrouded the flight of Mr. F. C. Chichester to Australia. The facts are that he learnt to fly three months ago, and since then has more or less lived in the air, so that he has a total of 200 hours to his credit already. He was flying a Gipsy Moth, which had extra fuel tanks, giving it a capacity of 59 galls. This was made up by the usual centre section tank of 19 galls., with extra tanks in the passengers' seat and the luggage locker of 20 galls. each. He is 34 years old, and unmarried, and seems to have had a meteoritic career in New Zealand, so that he is already a director of five companies. He left Croydon without ostentation at 3 a.m. on Friday, the 20th, and arrived at Lyons at 10.22 a.m.: continuing he arrived at Pisa that night and left at 2 a.m. the next morning for Catania (Sicily) at 9.40 a.m. Nothing further was heard until a report came through that he had forced landed near Tripoli after leaving Catania at 12.55 p.m. It would appear that he was forced to come down in some salt marshes due to engine trouble.

Mons. Bleriot's Film

The Guild of Air Pilots and Air Navigators of the British Empire, by the courtesy of Mr. Alexander Duckham, has arranged for its members, a private exhibition of M. Louis Bleriot's Film "25 Years of Aviation," on Wednesday, January 8, 1930, at 8.30 p.m. at the Edibel Cinema, 89-91, Wardour Street, W. 1.

The exhibition is open to members and friends without charge, and children will be especially welcome.

Accommodation is limited, and members are advised to make early application for seats to the Clerk to the Guild, 61, Cheapside, E.C. 2, stating number of seats required.

The Junkers-Ford Controversy

An embargo has been put on the three-engined Ford monoplane which the Spanish Air Company bought for use on its Madrid-Seville service. A protest for alleged infringement of patent rights had been entered by the Junkers Company.

A Royal Tragedy in Abyssinia

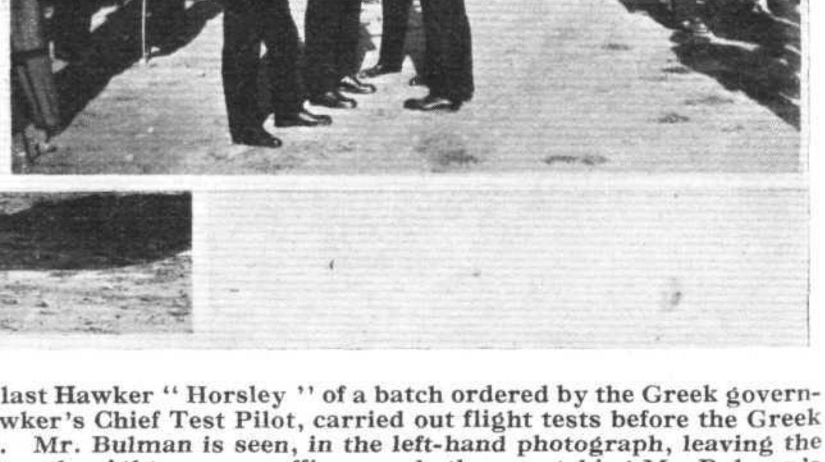
An uncle of Ras Taffari, the King-Regent of Abyssinia, was killed in an air crash at Densie, North Abyssinia, on December 22.

The "Lascondor"

The three engined saloon Monoplane, "Lascondor," is nearing completion at the Melbourne (Australia) Airport Factory and will be in active commission shortly. The "Lascondor" is being specially built for service on the 1930 Port Augusta–Mildura–Cootamundra–Sydney route, and is being fitted with a number of novel devices to ensure the additional comfort of travellers.

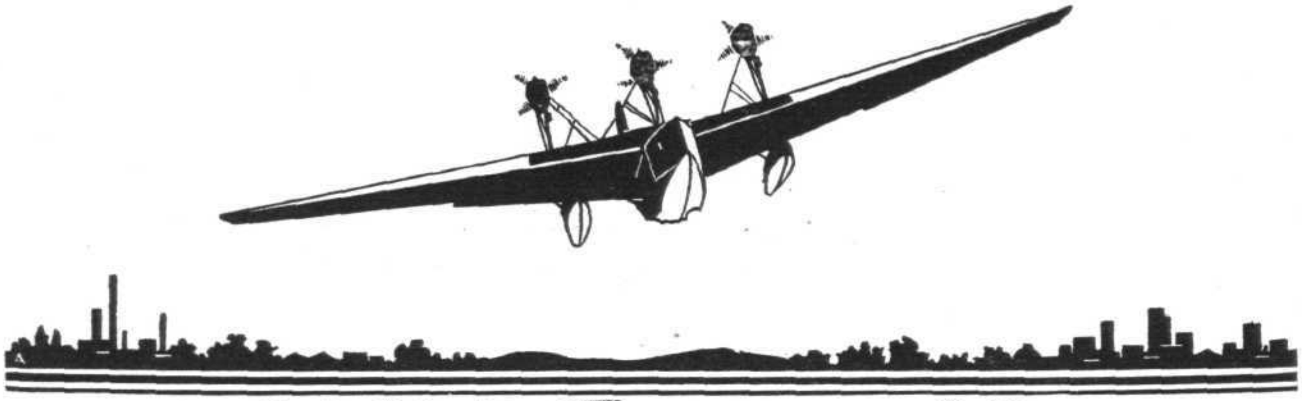
Glider Developments in U.S.A.

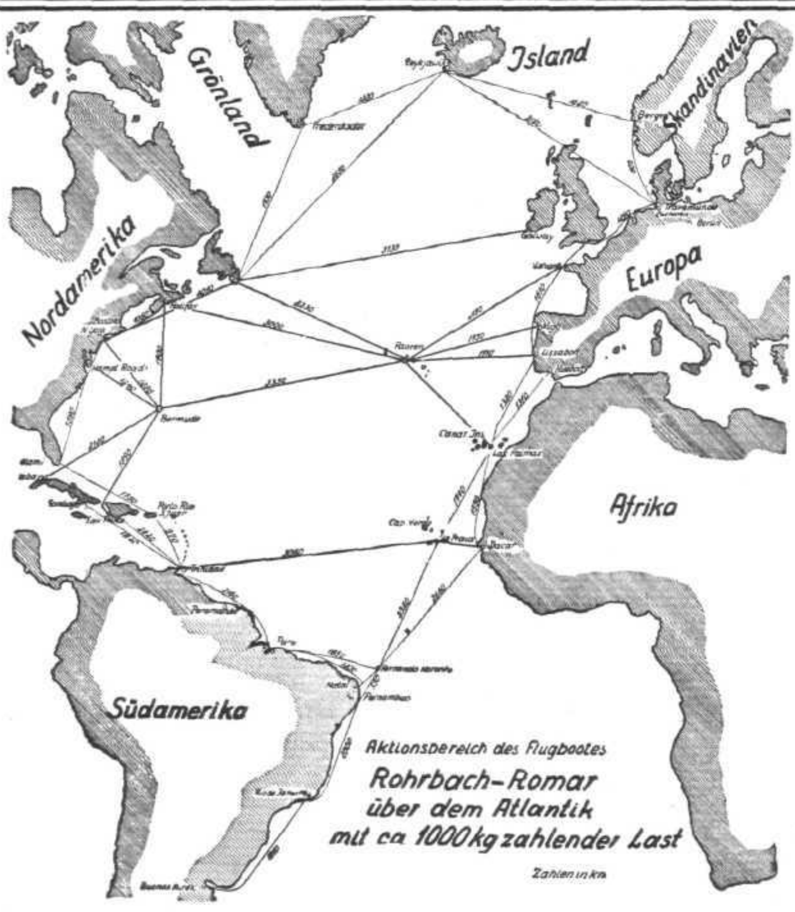
Gliders Incorporated will now be known as a division of the Detroit Aircraft Corporation, their equipment will be removed to Plant number Four of the Company at 115, Campau Street, Detroit, where the complete line will be manufactured. Two gliders, to be used in experimental work, have been purchased by Parks Air College from Gliders, Inc., a division of the Detroit Aircraft Corporation of which Parks Air College is also a subsidiary. The gliders, which will be delivered during the coming week, will be flown exclusively by members of the instruction staff of Parks Air College.



HAWKER "HORSLEYS" FOR GREECE: The last Hawker "Horsley" of a batch ordered by the Greek government was delivered recently. Mr. Bulman, Hawker's Chief Test Pilot, carried out flight tests before the Greek authorities and gave a very fine demonstration. Mr. Bulman is seen, in the left-hand photograph, leaving the machine with the Greek Minister of Marine, and on the right are seen officers and others watching Mr. Bulman's demonstration.

Save time by using the Air Mail.





Point 1. Seaworthiness in a sea of force 5 (Beaufort Scale) and a range of 4000 km. with adequate payload being guaranteed at contract conclusion.

Point 2. The boat being stranded on a storm-swept night (November 16-17th, 1928) without suffering the least injury.

Point 3. Standing up excellently in official seaworthiness tests (sea of force 5), on December 11th and 13th, 1928.

Point 4. Crowning acceptance flights by world's record ; lifting a maximum payload of 6450 kg. to a height of 2000 m.

Point 5. Flying ten hours non-stop from Travemünde to Stockholm and back, by order of Deutsche Luft Hansa.

Point 6. Flying non-stop over five countries, viz.: Germany (Travemünde)—Holland—England—Norway—Denmark and back to Travemünde airport, this flight also being made by order of Deutsche Luft Hansa.

The six foregoing feats prove the "Rohrbach-Romar" to be the trans-ocean flying-boat of the future.

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The AIRCRAFT ENGINEER

FLIGHT ENGINEERING SECTION

Edited by C. M. POULSEN

December 27, 1929

CONTENTS

EDITORIAL VIEWS

With the present issue of THE AIRCRAFT ENGINEER we complete four years of publication of this monthly technical supplement to FLIGHT. Judging from correspondence and conversations, it is evident that THE AIRCRAFT ENGINEER is greatly appreciated in the drawing offices of not only British but foreign aircraft firms, and among the more technically-minded of our readers. This, naturally, is a source of gratification to those responsible for publishing the paper, and we would take this opportunity to thank all those who, by letter or by word of mouth, have so kindly expressed their appreciation of our efforts.

If THE AIRCRAFT ENGINEER is to continue its work and maintain its high technical standard, it is necessary that "the Trade" should do its share by contributing articles. As time goes on, the work of producing service aircraft becomes more and more complicated, and it is small wonder that the chief designers of our industry find difficulty in sparing the time to write articles. But as we have previously pointed out, one of our aims is to interest and instruct the drawing office staffs, down to the most junior draughtsman, and so make our technical supplement not only a medium for the interchange of ideas, but also a paper of educational value. In order to do this adequately, it is necessary that the chief designers and engineers of the industry should share some of their accumulated experience with the younger members of the drawing office staffs, and we, therefore, hope that in 1930 the twenty-odd chief designers will help by sending us articles. In the meantime we thank all those contributors who, in 1929, have helped to make THE AIRCRAFT ENGINEER such an interesting feature of FLIGHT.

In the present issue, Mr. Pollard, in charge of metal construction at Bristols, continues his series of articles on metal construction with an examination of some simplified frames in the wing of large monoplanes. Mr. A. E. Russell, in charge of the Stress Department of the same firm, continues his article on "Load Factors," and Mr. Kearley continues his critical examination of the engines exhibited at Olympia. Mr. Andrews, of the Avro Technical Staff, has contributed an article on "The Estimation of No-lift Characteristics, the first instalment of which is published this month.

METAL CONSTRUCTION DEVELOPMENT

(*continued from p.* 61)

By H. J. POLLARD, Wh. Ex., A.F.R.Ae. Soc.

Everyone who keeps in touch with current aircraft publications will be aware that a considerable amount of literature is growing up round the subject of the relative methods of monoplanes and biplanes, and will also know that in spite of this growing literature, opinions are becoming still more sharply divided. No one believes that either type will completely oust the other, but the widest divisions of opinion exist as to which is the better type for particular duties.

Considerable expenditures of different kinds of energy and money appear to have settled the issue in special cases. A good instance is the recent race for the Schneider Trophy. By such experiments and trials spread over a period of years, we shall probably accumulate sufficient knowledge to enable us to predict which is the better type for some particular duties, or as regards these cases to know definitely whether there is much in it either way.

A purely mathematical solution of the general problem is, on the face of it, an impossibility. It has been suggested that considerable progress could be made fairly quickly if a machine of each type were designed for certain useful work under specified conditions, and that by calculations alone fairly conclusive results would be obtained.

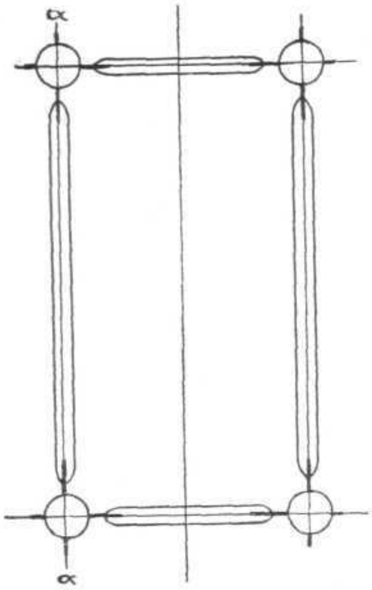
Experience indicates conclusively that such a method of attack would do little to convince those chiefly interested in aviation that the conclusions were the last and incontrovertible word on the subject.

If one of, say, 20 designers in the course of a year or so, with the help of a large staff, published his results, probably each of the other 19 would say that he, with an equally large and efficient staff, would have designed along other structural lines, arrangement of power plant and so forth, and that by other interpretations of the desiderata would inevitably have obtained different conclusions.

Whilst, however, results obtained by calculation alone are not likely to lead very far towards a solution of the general problem, it should be possible to tackle small parts of it and enable us to settle the *probable* line of construction which will result in those actual figures of performance, weight-carrying capacity, cost, etc., which alone will decide which construction is the better.

A relatively simple beginning can be made by an elementary investigation of monoplane wing structures. An examination of existing monoplanes reveals the fact that about half are of pure cantilever form and the wings of the others are semi-cantilever structures with a sprinkling of sesquiplanes

both pure and semi-cantilever wings being used on machines that are in most other respects similar. On the face of it such differences in wing arrangements should materially affect performance, weight-carrying capacity, and rigidity;



SECTION ON ZZ.

α - α IS FIGS. 2 & 3 IN OTHER VIEW

FIG. 1.

we can, however, by making assumptions, rapidly obtain weight and performance comparisons. Remarks on the assumptions will be made later.

Let us consider a spar of which the section is shown in Fig. 1. It consists of two plane frames suitably braced together in plan view; Fig. 2 represents one of the frames, *i.e.*, half the spar. The frame is held at U*u* and is subjected to a load W at each panel point, as shown. Reference will be made to the dotted portion of the frame later.

Consider the top or compression boom: since the length of each bay is equal to the depth, the loads in the bays from the tip towards the root are respectively

W, 3W, 6W, 10W, 15W . . . and in the *n*th boom

$$\frac{\text{factorial } (n+1) \times \text{W}}{\text{factorial } (n-1) \times 2} \text{ or } \frac{(n+1)\,!}{(n-1)\,!} \times \frac{\text{W}}{2} \quad \ldots\ldots\ldots\ldots\ldots \quad (1)$$

The sum of the loads in the upper booms up to and including the *n*th is

$$\frac{n\,(n+1)\,(n+2)}{6} \times \text{W} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

(For a proof of expressions (1) and (2) the reader is referred to any text-book on algebra dealing with figurate numbers.) The loads in the verticals are

W, 2W, 3W.........and m W in the mth strut. The sum of these loads, since they are in arithmetical progression, is

$$\frac{m\,(\,m+1)}{2} \times \text{W}$$

Similarly, from the geometry of the frame the sum of the loads in the ties from A*b* to the *p*th tie inclusive, is

$$\frac{p\,(p+1)}{2} \times 1{\cdot}414 \times \text{W}.$$

We have merely to give the value of the stresses in the members (it is assumed that the stress is uniform in all similar members) and the density of the material to get the theoretical weight of the members exclusive of any fittings. The weight of the top boom, for instance, is

$$\frac{n\,(n+1)\,(n+2)\text{W}}{6 \times f} \times \text{L} \times u$$

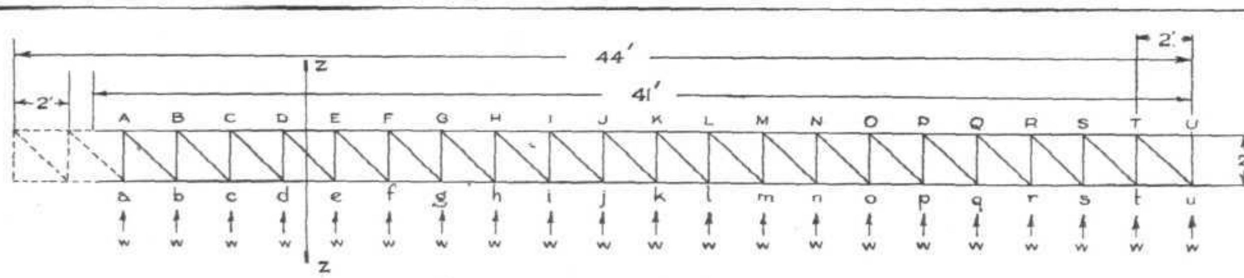


FIG. 2.

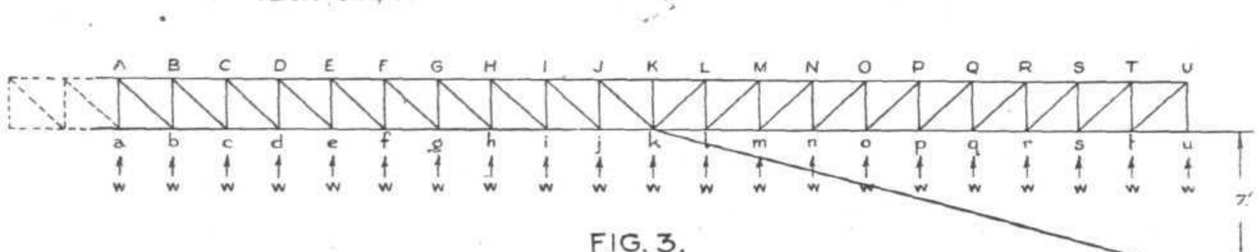


FIG. 3.

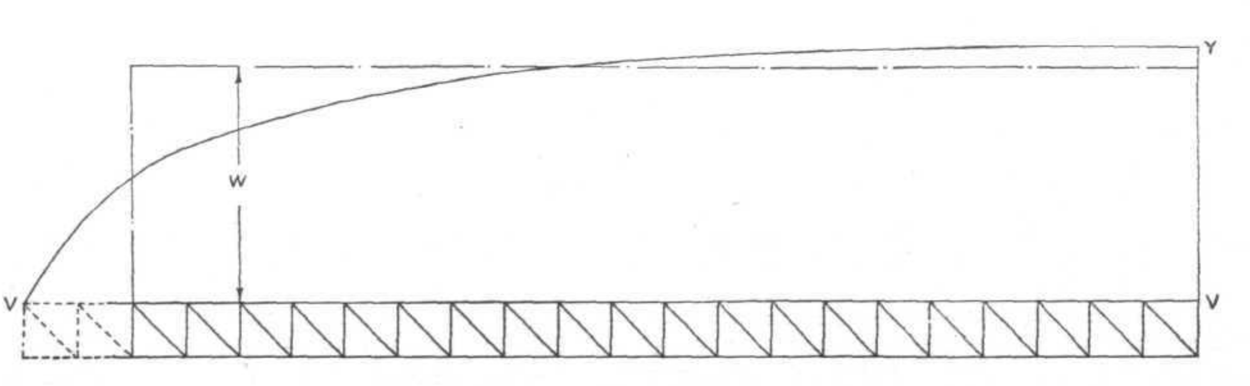


FIG. 4.

Pollard

f, l and u being the stress, length, and weight respectively in consistent units.

The theoretical weight of the frame without fittings is thus obtained in a few minutes.

With the introduction of an external tie a simple summation of the stresses can again be made, neglecting the stress induced by end load and deflection. If a point of zero shear occurs between the additional point of support and the root the summation is more readily effected in two parts, but since we are not concerned at the moment with variation of frame weight as affected by the position of attachment of external tie, we will take the anchorage point at k, as shown in Fig. 3. Then, obviously, the weight of the top boom at the right of K equals the weight on the left; similarly, the weight of the ties and struts to the right of Kk equals the weight on the left, while the sum of the tension loads in bottom booms to the right of K is 55 W and the sum of the compressive loads is 78 W for the angle of the external tie, as shown.

We are now in a position to assess the weights of the two frames.

Suppose W $=$ 450 lbs.
f_1 $=$ 35 tons per sq. in. for top and bottom booms.
f_2 $=$ 20 tons per sq. in. for struts
f_3 $=$ 40 ,, ,, for the ties.
l $=$ d 24 in.
and u $=$ 0·283 lb. per cub. in.

Case 1: Pure cantilever.

$$n = 20$$

$$\text{Weight of top booms} = \frac{20\times21\times22\times450\times24\times0\cdot283}{6\times2240\times f_1} = 60$$

$$\text{Weight of bottom booms} = \frac{19\times20\times21\times \text{W, etc.}}{6\times f} = 52$$

$$\text{Weight of struts} = \frac{20+10+19\times\text{W, etc.}}{f_2} = 33\tfrac{1}{2}$$

The weight of the ties is since we have $(1\cdot414)^2$ in the numerator, and $f_3 = 2\ f_2$ in the denominator equal to the weight of the struts. We can then take the weight of the "structure" less gusset plates, fittings, etc., as 180 lbs.

Case 2. Weight of top booms is

$$\frac{2\times10\times11\times12\times\text{W}}{f} = 17$$

and so on for the other members, and we arrive at a weight of 37 lbs. total.

Such a computation ignores the member Kk, and in both cases bottom bay aA, but allowances can be made for the weight of these in what follows.

Now regarding the tie kX which is acting as a support for the complete spar section shown in Fig. 1: the best we can do in estimating the weight of this is to assume that it has to withstand a certain compressive load which we will arbitrarily fix at 6,000 lbs. The length of the member is say 250 in., and its weight might be 60 lbs.

With these figures and the "guesses" that are to follow let us endeavour to get the difference in wing weights of two aeroplanes having wing arrangements as shown in Figs. 2 and 3, there being two spars per wing.

We have seen a theoretical weight saving of approximately 2×140 lbs., for a complete front spar.

As regards the rear spar with its smaller loads and consequent less economic use of metal we will put the saving at 140 lbs. and the weight of the external tie at 40 lbs.

Weight of sockets for these struts, fittings at spar attachments, say 20 lbs.

Take the weight of the heavy centre section of the wing, passing over the body of the pure cantilever machine to balance the weight of the centre part of the fuselage of the semi-cantilever machine caused by the forces from the external ties.

Again in the case of the cantilever wing some weight is needed for an anti-torsion device, say 30 lbs. Also because of the heavy loads in the bracing of the cantilever near the root, we will say 15 lbs. extra for heavier gussets at the inner ends of the two spars.

We will assume that the weights of the plan view bracing of the spars and any bulkhead bracing "cancel out" in the two cases. The reader is at liberty to vary the above assumed weights as he pleases, but it appears to be satisfactory to take the nett difference for a complete half wing as $(280+140+30+15)-(100+20)=345$. or for the full wing structure we will take the difference in round figures to be 700 lbs.

Now, as regards the weight of an aeroplane, in the first instance, let us assume this to be 17,000 lbs., the wing weight being 3,000 lbs. Then taking two-thirds of the total *nett* load carried on the front spar with a factor of 4 and the length of *each* wing 44 ft. or 41 ft. effectively loaded (see below), we arrive at an average load per foot run of spar of approximately 450 lbs. or 225 lbs. per foot run of each girder, since the length of each bay is 2 ft. This gives 450 lbs. at each panel point.

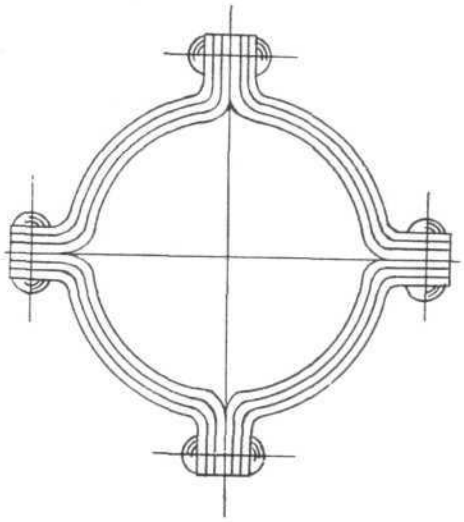


FIG. 5.

With reference to our assumptions: A load grading along the span for such a wing as we have taken might be as shown in Fig. 4, we have simply neglected the end 3 ft. and assumed uniform loading along the rest of the span; if we had taken the *exact* loading at each panel point and performed long and laborious calculations, the figure of 280 lbs. would *not* have been seriously affected. Again, as to the assumption that we have equal stresses in similar members, if the booms are of the form shown in Fig. 5, beginning with four strips in bays AB and ab, we should have 23 separate pieces of strip in bay TU. *This is a feasible proposition.*

Regarding the assumption that the metal is working to its full capacity in all parts. Take bay AB:

The load in the member is 450 lbs.
Its L/K is, say, 53.
∴ the K is 0·4 approx.

$$\text{and the area is } \frac{450}{35\times2240} = 0\cdot00574$$

where 35 tons per square inch is the collapsing stress of the strut for the above value of L/K. The developed width of the four strips, say, 6 in., giving a material thickness of about 0·001 in.

We are here outside a practical construction, regarding the attainment of a structure of uniform stress, and for the booms we may say that 0·05 sq. in. is the minimum area, consequently, from bay DE we cannot get down to the areas required for constant stress. We should in this case have 20 separate strips in the root bay of the top boom. There is likely to be more of this useless strength in the semi-cantilever spar and, therefore, it is unlikely that the difference in weights would be as much as 700 lbs. for this construction. Moreover, we are now able to see more clearly why such a

low stress was necessary in the struts, simply because a high value of K is not practicable.

Although the amount of material is varied from bay to bay through nearly the whole length of the spar, it is not likely that the area of metal at any particular section would be exactly that necessary to bring the plotted P/A and L/K exactly on to the strut curve for the material (this point of course, cannot lie about the curve for the assumption of pin jointed struts), since no variation could be made to the width or thickness of each separate strip. This limitation to the ideal value of A or possible "unnecessary weight" due to the points lying below the curve applies equally well in both structures and the net differences in weight should not be appreciably affected by it.

The reader will no doubt feel that there is a good substratum of actual fact underlying most of the assumptions, and we may now proceed to examine the performance of the two machines, extending the case of the semi-cantilever wing arrangement to a machine of larger aspect ratio, but of the same wing area.

From the foregoing considerations and those to follow the complicated nature of the problems facing the designer become evident. It is only by working through such a simple example, using elementary methods, that one begins to realise all or many of the side issues which come into and influence questions of general design.

Making allowance for some of these side issues, it may be possible at a later date to give a more general treatment to this particular problem.

LOAD FACTORS

By A. E. RUSSELL, B.Sc., A.M.I.A.E.

(Continued from page 83)

The next most simple manœuvre is the banked turn. First, as a matter of interest let us consider the minimum radius of turn that an aeroplane can change direction in. The limit is the vertically banked turn when the wing lift equals the centripetal force or

$$L = k_L \rho S V^2 = \frac{W}{g}\frac{V^2}{R}$$

$$k_L \rho S = \frac{W}{gR}$$

$R =$ the radius of turn.

Since $W = k_L \max, \ \rho S V^2$

$$R = \frac{k_L \max}{k_L}, \ \frac{Vs^2}{g}$$

With the wings vertical and the stick pulled back to hold the angle of incidence up to the maximum lift value, with a stalling speed of 60 m.p.h. it is impossible to turn in a smaller radius than 240 ft. For a fast machine with a stalling speed of 100 m.p.h. the minimum radius of turn would be 670 ft.

This simple relationship will not hold for all types of aircraft, since the size has an effect on the minimum radius; to determine this effect the expressions for control and damping moments are equated. The pitching moment due to pitch

$$qMq = k' S_T l^2 V_q$$

Where k' is a coefficient of damping and is equal to the slope of the lift coefficient of the tail plane and the other letters have their usual meaning, while the moment due to the tail plane

$$M = k_y \rho S_T V^2 l$$

Therefore $$K l q = k_y \rho V$$

$$\frac{V}{q} = R = \frac{k'.l}{k_y \rho}$$

When turns of maximum possible rapidity are required k_y, the tail plane lift coefficient, must be as large as possible, *i.e.*, the value with maximum positive elevator setting. From this second case we see that the minimum radius is proportional to the length of the aircraft, though only large lightly loaded machines are governed by this condition.

From the aerodynamic point of view, the vertically banked turn is almost identical with the pull out, and since the rolling moment is small the condition is covered in the stress calculations by the latter case. The load factor would not be expected to be as high as in the pull out since the speed of the dive may be considerably higher than the top speed of the aircraft, while it is unlikely that a vertical bank would be commenced except from approximately horizontal flight. Owing to the rapid fall of speed in the pull out, due to gain of potential energy and higher drag due to increased incidence, the load factor quickly drops, while in the banked turn, although drag due to incidence increases the speed may be maintained by loss of potential energy, *i.e.*, loss of height, so that the load factor may remain high throughout the manœuvre, this steady load is more uncomfortable for the pilot. A normal healthy pilot can withstand 8*g* and higher with practice, so long as the acceleration is not maintained, while 4*g* to 5*g* continued for several seconds may result in complete loss of the faculties, and if lasting 10 to 12 seconds would result in death. This is due to the blood being driven from the head, depriving the brain of the necessary oxygen.

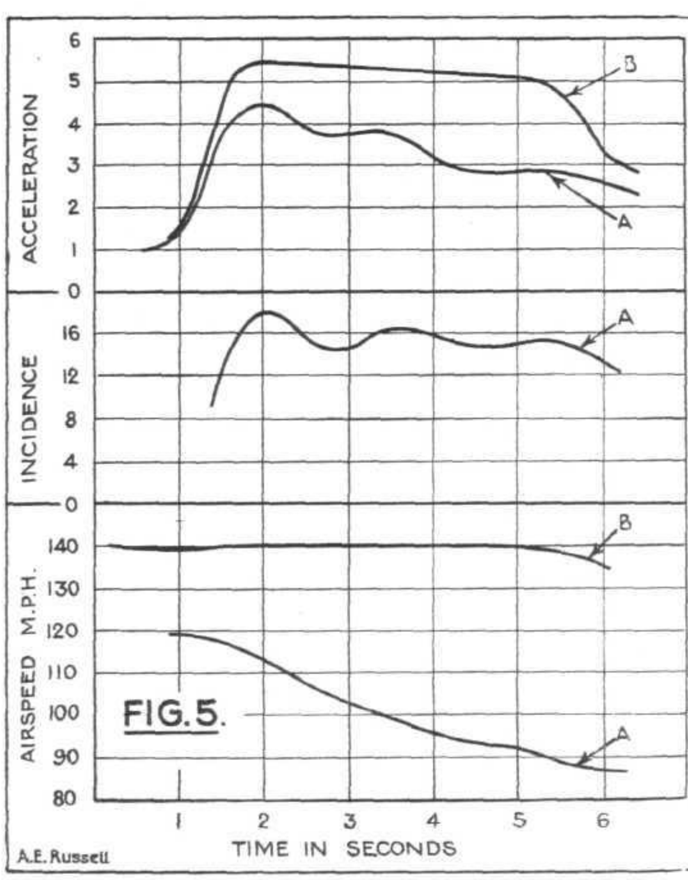


Fig. 5 shows accelerations in two different types of steeply banked turns, 5A shows a turn without loss of altitude and 5B shows a turn in which the speed is kept constant by loss of height.

Inverted flying may be placed in the same class as the manœuvres already considered where rolling moments are only incidental and small so that the loading is symmetrical about the centre line of the aircraft, the only accelerations are therefore in the longitudinal and vertical axes of the machine.

The inverted attitude may be attained most easily by a slow half-roll when the horizon may be watched throughout the manœuvre, in this case accelerations are small. A second method is to half loop and remain in the inverted attitude, but since the airspeed at the top of the loop is usually low, and the inverted stalling speed may be 20 to 30 per cent. in excess of the normal stalling speed, this method may be ruled out. The third method is to push the control column forward, putting the machine into a short dive and pulling out in the inverted position; this is usually called the first

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half of the outside loop, *i.e.*, the pilot is on the outside of the curve, tending to be thrown out of the cockpit. This third method has been the subject for mathematical investigation on the possibility of the inverted loop. The aircraft was assumed diving at 180 f.p.s. at $-20°$ to the horizon, when the elevators were suddenly set at $+15°$. Only half a second after the elevators were set, the load factor changes from a positive value of approximately unity to a negative value of 3. Contrary to what might be expected, the speed quickly drops. After reaching the bottom of the loop, the flight path follows a straight line, still losing height. The speed at the bottom was only about 130 f.p.s. Even if the elevator setting is eased in the dive in order to gain speed, it is extremely unlikely that a complete outside loop is possible, unless the engine can still function when inverted. The load factor in pulling out of the dive into the inverted position may be calculated in the same manner as the normal case, except that V_s becomes the inverted stalling speed; since speed is on an average 20 per cent. in excess of the normal stalling speed, the maximum inverted load factor is approximately $\frac{1}{1.2^2}$ or two-thirds the normal value; for symmetrical sections, of course, conditions are the same as in normal flight.

The strength of an aircraft is normally only investigated under symmetrical aerodynamic loading. The centre of pressure is assumed in its most forward position, and the angle of incidence that of maximum lift: this is somewhat harsh, since the centre of pressure usually moves back slightly as the stall is approached. If N_1 is the factor required, the speed of the machine is taken as $\sqrt{\frac{N_1}{2}}$ times stalling speed, this corresponds to a factor of safety of 2 when the incidence is instantaneously increased to that of maximum lift when travelling at the speed of $\sqrt{\frac{N_1}{2}}$ stalling speed. For normal aerobatics, this is probably as severe a condition as is likely to occur, only when a pilot deliberately tries to produce high ccelerations is the factor of safety of 2 reduced. A second condition for strength investigation is similar. The centre of pressure and the attitude are taken as those corresponding to the top speed of the aircraft. The factor called for in this case, N_2, is three-quarters of that required when the centre of pressure is forward. This case does not correspond to a factor of safety of 2 when pulling out of a dive into the top speed attitude, since $\sqrt{\frac{N_2}{2}}$ times the top speed sometimes exceeds the terminal velocity of the aircraft; moreover, this factor N_2 is only required on the wings. We shall see that this case covers conditions as are found in manœuvres involving angular displacement, when, though the normal acceleration may be low, local loading on the wings may be high. Inverted flight is covered by a factor usually two-thirds that of the C.P. forward case.

(To be continued.)

AN ANALYTICAL REVIEW OF THE AERO ENGINE EXHIBITS AT OLYMPIA

(Continued from p. 88)

By N. E. KEARLEY, A.M.I.E.E., A.M.I.A.E.

Water-Cooled Engines

General Remarks.—Table II deals with all the water-cooled engines shown at Olympia in a manner similar to that previously employed with reference to the air-cooled engines (*See* the AIRCRAFT ENGINEER of September 27, 1929) the engines being arranged in order of power in their separate classes. The cylinder dimensions, crankshaft speeds, weights, and other data from which the figures given in Table II have been deduced are not included as these have already been published in the July 25 issue of FLIGHT. Before studying Table II closely it should be remembered that three engines have been included which cannot fairly be compared with the others, these three engines being the Lion VII B racing engine and the two Sunbeam exhibits, one of the latter being an airship engine of somewhat bewildering proportions, whilst the other is an experimental compression ignition engine.

It will be noted from Table II that the figures obtained for each of the three classes are all in fairly close agreement irrespective of make or power. For instance, the highest and lowest piston speeds of the V-type engines are within about 17 per cent. of each other, the average being about 2,200 ft. per minute, whilst the stroke/bore ratios are practically all between 1·07 and 1·2, the exceptions being the Renaults and the Mercedes-Benz. It is also of interest to observe that these two factors are very little influenced by cylinder arrangement, although the in-line engines tend to have higher stroke/bore ratios than the other arrangements, but, as they are all of the direct drive type, their mean piston speeds are lower than those of the geared type. There are three exceptionally interesting engines in the broad arrow class, namely, the racing Lion, the new Lorraine type 48·5 (a curious and mysterious designation), and the 18-cylinder Farman inverted engine. The mean piston speed of the racing Lion is 2,750 ft. per minute at normal revolutions per minute, which although considerably above the average of those in Table II, is not so very much greater than that of the geared Jupiter, the engine having the highest piston speed of any of those at the Show, excepting the Lion VII B. The latter engine, however, has a mean piston speed of over 3,000 ft. per minute at maximum crankshaft speed, which in this case is near the actual working speed and therefore forms a fairer basis of comparison than the "normal" r.p.m. The two French engines previously mentioned, the Farman and the Lorraine, are of interest on account of their low weight/power ratio, both being very little over $1\frac{1}{2}$ lb. per b.h.p., based on normal output. A close rival to these two, but in the V-cylindered class, is the Hispano-Suiza 12 Nb. This, however, is a direct drive engine, whilst the other two are both geared, although the Lorraine may be easily converted to provide a direct drive, when the weight/power ratio is reduced to 1·42 lb. per b.h.p. Both the Lorraine and the Hispano-Suiza are unusual in having six carburettors, this apparent sacrifice in the saving of weight, being made, presumably, in the interests of the fuel economy resulting from the improved distribution of mixture to the cylinders. Incidentally it may be observed that since the beginning of this review the world's long-distance point-to-point record has changed hands from the Fiat direct drive V-type 12-cylinder water-cooled engine to a Hispano-Suiza engine of similar type and rating, the present record holder differing only from the 12 Nb. in bore, this being 140 mm. against 150 mm. for the engine exhibited at Olympia, the rated output of the record breaking engine being 600 h.p. The Farman engine is remarkable in having a large number of cylinders of small dimensions together with a reduction gear giving a lower ratio (*i.e.*, airscrew revs./crankshaft revs.) than any other engine in the Show, the result of this combination being that although the normal crankshaft speed is nearly that of the racing Lion the mean piston speed is not so very much above the average.

With regard to the brake mean effective pressures, Table II shows a considerable variation in values, ranging from about 100 lbs. per sq. in. in the in-line engines up to as high as 147 lbs. per sq. in. in the other types, the racing Lion being excepted, as with a compression ratio of 10 : 1 it can, of course, only be run on doped fuels and cannot therefore be considered with the other engines. The compression ratios are high in some cases, as for instance the Rolls-Royce, these engines having been designed for use in high altitude aircraft.

In the matter of weight/power ratio there appears to be little to choose between the V and broad arrow classes of similar output. Where 2 lbs. per b.h.p. is exceeded in these two classes it will be found that the engines are of an obsolescent type, with the exception of the Mercedes-Benz F 2 and the Sunbeam Sikh III. The output/capacity varies

Table II.—Water-Cooled Engines.

rmal tput, H.P.	Name or Type.	Maker.	Stroke/bore.	Compression Ratio.	B.M.E.P. lbs. per sq. in.	Piston Speed, ft. per min.	Weight per B.H.P.-lb.	B.H.P. per litre.	Weight per litre. lb.	Remarks.
					12-Cyl. Vee.					
,000	Sikh III	Sunbeam	1·14	5·0	116	2,280	2·76	14·8	41·0	Airship engine.
950	A 25	Fiat	1·18	5·25	132	2,260	1·95	17·5	34·2	Direct drive.
825	H. X	Rolls-Royce	1·1	5·25	147	2,200	1·77	24·8	44·0	Medium supercharger.
800	F 2	Mércedes-Benz	1·27	—	124	2,140	2·25	14·8	33·4	Air fed by controlled compressor.
650	12 Nb	Hispano-Suiza	1·13	6·2	117	2,230	1·59	18·0	28·6	Direct drive.
570	12 Kh	Renault	1·34	5·6	127	2,250	2·05	18·7	38·4	
570	A 22	Fiat	1·18	5·5	141	1,990	1·77	20·4	36·2	Direct drive.
550	12 Kg	Renault	1·34	5·6	130	2,130	1·89	18·0	34·0	Direct drive.
525	XI M.S.	Rolls-Royce	1·1	5·5	143	2,060	1·71	24·8	42·5	Normal output maintained to 3,000 ft.
518	Asso	Isotta-Fraschini	1·07	5·7	131	1,820	1·78	18·7	33·4	Direct drive.
500	12 HDr	Hispano-Suiza	1·07	6·2	117	1,970	2·06	18·1	37·2	
500	12 Jo	Renault	1·36	5·6	140	2,250	1·78	20·0	35·6	
490	F XI & XII A	Rolls-Royce	1·1	7·0	133	2,060	1·76	23·1	40·7	
480	F XI & XII B	,, ,, ...	1·1	6·0	130	2,060	1·8	22·6	40·7	
450	12 Ja	Renault	1·36	5·6	132	2,000	1·81	18·0	32·6	Direct drive.
					Broad-Arrow.					
1,000	Asso R.I.	Isótta-Fraschini	1·2	5·3	113	2,010	1·77	17·5	31·0	18 cylinders; 40° between banks.
812	Lion VII B	Napier	1·08	10·0	157	2,750	1·25	36·4	45·5	Racing engine.
660	48·5	Lorraine	1·1	6·0	134	2,100	1·56	20·8	32·4	
650	18 Kd	Lorraine	1·5	6·0	115	2,370	2·03	17·7	36·0	18 cylinders.
600	18 Wi	Farman	1·13	5·7	130	2,300	1·55	28·0	43·4	18 cylinders inverted, supercharged.
530	Lion XI	Napier	1·08	6·0	131	2,150	1·75	23·7	41·5	
450	12 Ed.	Lorraine	1·5	6·0	126	2,250	2·01	18·5	37·2	
450	Lion V	Napier	1·08	5·8	131	1,830	2·1	20·2	42·5	
					6-Cyl. in-Line.					
305	Nimbus	A.D.C.	1·25	5·4	99	1,810	2·19	14·7	32·2	Direct drive.
104	P.I.	Sunbeam	1·08	12·0	102	1,280	4·22	11·8	51·0	Compression ignition.
100	Pa	Hispano-Suiza	1·27	5·5	82	1,840	3·74	12·7	47·5	Direct drive.

onsiderably between the various makes, ranging from 14·8 o 28 b.h.p. per litre in the two main classes, but there is iot that marked difference between the British and the oreign engines which was observed when this ratio was xamined in relation to the air-cooled engines at the Show. The weight/capacity ratio given in the last column shows hat cylinder arrangement has very little influence in this lirection. The unusually low figure of 28·6 lbs. per litre chieved by the 650 h.p. Hispano-Suiza type 12 Nb. is ioteworthy.

The general similarities between the values in the various columns of Table 11 shows that modern water-cooled engines have developed into more or less standard types and, as it may be fairly assumed that the various makers have reached these common standards independently, it seems that water-cooled engine design has almost reached finality—it now remains for development to take place in some new direction, *e.g.*, for evaporative cooling to become more general. The fitting of superchargers does not call for any radical change in design or arrangement other than in the carburettors and mixture distributing means. In the case of aero engines, superchargers may be regarded as accessories fitted to enable special conditions to be met; as the weight per horse-power is considerably increased at normal altitudes, and the fuel consumption is heavier, it does not appear likely that superchargers will come into general use.

Before leaving Table II, some interesting comparisons may be made with the values contained in Table I, previously published. Firstly, it should be noted that whereas 89 per cent. of the water-cooled engines at the show were of over 450 h.p. of the air-cooled engines, 45 per cent. were of under 100 h.p., 40 per cent. between 100 and 300 h.p., and only 15 per cent. were of over 400 h.p. There is not a great deal of difference between the stroke/bore ratios, but as most of the water-cooled engines are geared they have considerably higher piston speeds. Compression ratios and brake mean effective pressures are definitely higher, cooling difficulties preventing the use of higher ratios than 6 : 1 in air-cooled engines, hence the popularity of the water-cooled engine for long-distance flights, for the improved thermal efficiency or economy in fuel consumption resulting from the higher compression ratio means a considerable saving in the weight of fuel for a long flight. The weight/power ratio cannot usefully be compared as in the case of water-cooled engines, the dry weight has been taken, and the total weight of the cooling equipment varies considerably with different installations. As a rough approximation, 0·6 lb. per b.h.p. may be added to the values given in Table II to obtain an estimate of the total weight per b.h.p.

It will be seen that the h.p./capacity ratios do not differ greatly in the two tables, nor do the weight/capacity values, though these also should be "weighted" to allow for the cooling equipment. A comparison of some of the constructional features of the water-cooled engines will next be considered.

Cylinder Arrangements and Construction.—The cylinder construction may be grouped in two main classes, irrespective of the arrangement of the cylinder banks, namely, the single block in which the barrels of each bank are surrounded by a common water-jacket, and the separate type in which the cylinder units, each with their separate jackets are assembled to a common head casting. The latter type may be subdivided to cover the different forms of water jacket, but two other distinct types of construction were to be found at the show, these being the entirely separate unit construction and the twin unit arrangement peculiar to the now obsolescent

Lorraine type 12 Ed. broad-arrow engine. These various constructions are divided among the water-cooled engines, as follows :—

Separate cylinders assembled to common head	44·5 per cent.
Single block	44·5 ,,
Separate units	7·5 ,,
Twin units	3·5 ,,

THE ESTIMATION OF NO-LIFT CHARACTERISTICS

(With a Discussion of the Results of the Tunnel Tests on the M1 to M27 Series)

By W. R. ANDREWS, Higher National Diploma (Hons.)

There are many causes making an estimate of the no-lift conditions of an aerofoil necessary.

The most frequent use made of the theoretical method is for obtaining the no-lift conditions of an aerofoil for which wind tunnel data is not available.

By comparing the theoretical and observed values for standard aerofoils a check is obtained on the reliability or otherwise of the theoretical values.

As most of the aerofoils in common use have centrelines which are convex upwards over the entire chord length, more information is available on this class of aerofoil than on those having the centreline reflexed at the trailing edge. The data on non-reflected aerofoils will be used to obtain the agreement or otherwise between observed and calculated values of no-lift.

Except in special cases where decalage or aerodynamic twist is introduced into a wing system, the most important quantity is the moment of the wing at no-lift.

Table 1

Section	Maximum Camber of Centre Line	Km_o Calculated.	Km_o Observed	Ratio :— Km_o obs. / Km_o calc.	Difference Km_o obs. Km_o calc.
R.A.F.25	0·01	−0·016	−0·016	1·0	0
28	0·02	−0·022	−0·02	0·91	0·002
26	0·02	−0·031	−0·028	0·904	0·003
31	0·02	−0·031	−0·029	0·937	0·002
15	0·026	−0·021	−0·018	0·86	0·003
Gott.436	0·035	−0·041	−0·035	0·855	0·006
R.A.F.32	0·05	−0·078	−0·068	0·872	0·01
Gott.386	0·0056	−0·058	−0·046	0·795	0·012
U.S.A.35	0·065	−0·074	−0·060	0·812	0·014

The observed and calculated values of Km_o for a few of the more important sections have been collected from various sources, and are tabulated in Table 1.

The aerofoil sections have been arranged in ascending order of maximum camber of centreline ratio γ as this function suggests a base whereby a comparison can be made.

The ratio and the difference between observed and calculated values of K_{mo} are given in the last two columns. By studying these, it is at once apparent that the difference, ΔK_m, between observed and calculated values, bears some relationship to the maximum camber of the centreline γ.

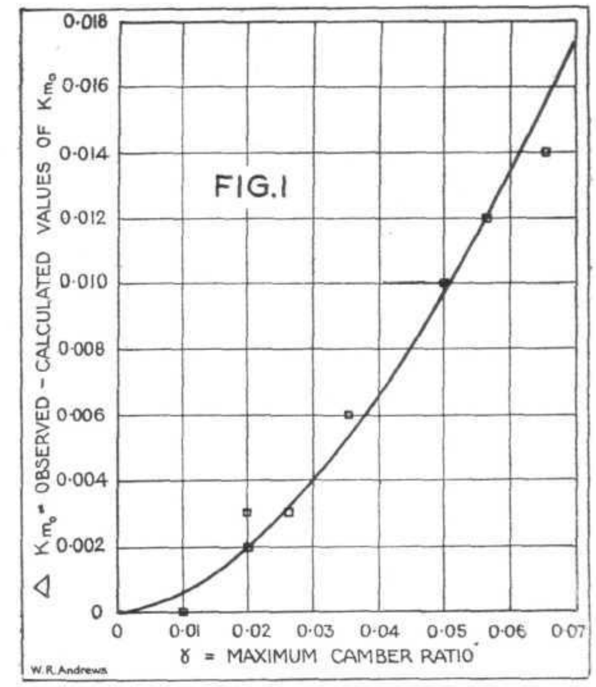
The ratio of calculated to observed values of K_{mo} does not show a regular decrease with increase in camber, nor is the value anything approaching a constant value, and can be ruled out.

Fig. 1 shows the relationship which is obtained by plotting the difference between observed and calculated Km_o's against the maximum camber of the centreline.

The mean curve, which has been drawn, follows the law :—

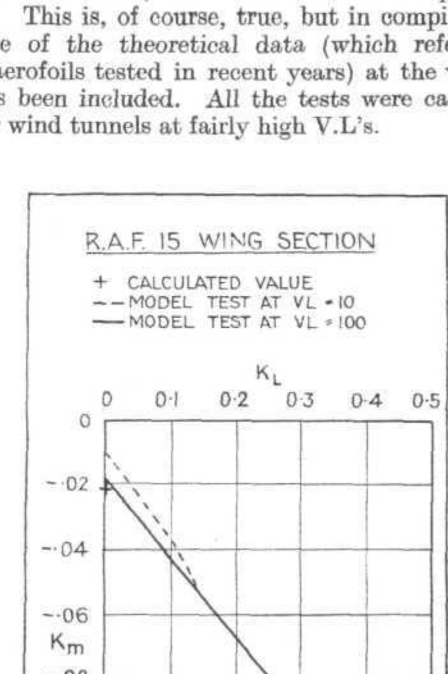
$$K_m = 1\cdot75\ \gamma^{1\cdot73} \quad \ldots\ldots(1)$$

The largest deviation of any point from the curve is 0·0014 which also roughly represents the accuracy to which the



calculated and observed values of K_{mo} are given. This curve gives a suggested correction to the calculated value of K_{mo}.

It may be argued that the foregoing relationship is purely coincidence, and that by choosing other aerofoils, tested in other Wind Tunnels, a different relationship might be obtained. This is, of course, true, but in compiling Table 1 the whole of the theoretical data (which refers to non-reflexed aerofoils tested in recent years) at the writer's disposal, has been included. All the tests were carried out in the larger wind tunnels at fairly high V.L's.



It is a well-known fact that with increasing VL, below a certain point, the value of K_{mo} becomes nore negative and the Km curve becomes more nearly straight. Fig. 2 gives the experimental values of Km for R.A.F. 15 aerofoil (R. & M. 910), and clearly indicates the changes which take place as the wind speed is increased.

This property should always be borne in mind when investigating the results of early experiments. Too much faith cannot be placed in the no-lift conditions obtained from some of these.

(*To be concluded.*)

TECHNICAL LITERATURE

SUMMARIES OF AERONAUTICAL RESEARCH COMMITTEE REPORTS

These Reports are published by His Majesty's Stationery Office, London, and may be purchased directly from H.M. Stationery Office at the following addresses: Adastral House, Kingsway, W.C.2; 120, George Street, Edinburgh; York Street, Manchester; 1, St. Andrew's Crescent, Cardiff; 15, Donegall Square West, Belfast, or through any bookseller.

NOTE ON THE EFFECT OF BODY INTERFERENCE ON THE EFFICIENCY OF AN AIRSCREW. By C. N. H. Lock, M.A. R. & M. No. 1238 (Ae. 393). (8 pages and 2 diagrams.) December, 1928. Price 6*d*. net.

A theory of airscrew body interference has recently been put forward (in R. & M. 1120*), which attempts to account for the change of thrust and torque of the screw by the standard methods of airscrew strip theory on the assumption that the whole effect of the body is represented by a modification of the axial component velocity through the airscrew disc. The theory applies strictly to a body of revolution having an indefinitely long parallel portion and a nose of easy shape continued through the airscrew by means of a spinner, so that the airflow over the nose in the absence of the airscrew may be represented with sufficient accuracy by the irrotational flow of a perfect fluid.

A formula for the effective efficiency is found in R. & M. 1120 and the object of the present note is to consider the basis of this result in more detail by a theoretical analysis of the power loss of the airscrew either with or without the body. For this purpose the power loss is analysed into the sum of three parts:—(A) and (B) the power associated with the axial and rotational component velocities of the slipstream respectively, and (C) the power wasted by the profile drag of the blade elements. Apart from its theoretical interest this analysis would be of practical use in calculating the effect on airscrew efficiency of small changes of design such as for example, changes of blade twist.

* Analysis of experiments on an airscrew in various positions within the nose of a tractor body. Lock.

THE APPLICATION OF THE THEORETICAL VELOCITY FIELD ROUND A SPHEROID TO CALCULATE THE PERFORMANCE OF AN AIRSCREW NEAR THE NOSE OF A STREAMLINE BODY. By C. N. H. Lock, M.A. R. & M. No. 1239 (Ae. 394). (4 pages and 2 diagrams.) December, 1928. Price 4*d*. net.

A theory of airscrew body interference has recently been put forward in R. & M. 1120*, which attempts to account for the change of thrust and torque of the screw by the standard methods of airscrew strip theory on the assumption that the whole effect of the body is represented by a modification of the axial component velocity through the airscrew disc.

If the body is of one of the simple forms such as the prolate spheroid for which the velocity field in a perfect fluid is known and the actual velocity field near the nose approximates closely to the theoretical field, then this note shows that the thrust and torque grading of any airscrew situated in this region can be deduced by theoretical calculation.

* Analysis of experiments on an airscrew in various positions within the nose of a tractor body. Lock.

ROLLING AND SIDESLIP EXPERIMENTS ON A MODEL SLOTTED BIPLANE OF R.A.F. 31 SECTION.—By H. B. IRVING, B.Sc., A. S. Batson, B.Sc., and A. L. MAIDENS. R. & M. No. 1240 (Ae. 395). (5 pages and 18 diagrams). February, 1929. Price 6*d*. net.

The increasing use of slotted wings has made it advisable that the range of data relating to them be considerably extended. This report gives the effects of rolling and sideslip (separately) on the rolling and yawing moments of a slotted biplane of the R.A.F. 31 section. The only previous data on the effect of rolling on slotted wings were obtained in 1924 and referred to a model monoplane originally of R.A.F. 15* section, but having its nose brought down to the chord line, and the slot formed by the addition of an auxiliary aerofoil.

No results have previously been obtained on the effect of sideslip on a slotted wing.

Measurements of rolling and yawing moments on a 6-in. by 36-in. model biplane (gap = chord, stagger 0°) of R.A.F. 31 section when rolling about the wind axis and for various angles of yaw (stationary) for the cases:—

(*a*) Wings slotted all along the span.
(*b*) Wings slotted at the tips only (chord length), centre portion R.A.F.31.
(*c*) Wings of R.A.F. 31 section all along span.

The unslotted biplane is highly unstable in roll just after the stall, the instability beginning at about 15° incidence. Tip slots only are not sufficient to overcome this instability but reduce it to about half, for slow rates of roll (Fig. 8). The biplane with tip slots afterwards becomes stable at about 19·5° incidence and continues so up to nearly 40°. On the other hand, with slots *all along* the span the biplane is stable in roll up to about 25° incidence and is then unstable up to 38° incidence.

The slotted biplane does not appear to show any peculiar features as regards rolling and yawing moment due to sideslip.

* R. & M. 1063. Model experiments on R.A.F. 31 aerofoil with Handley Page slot.—Irving, Batson and Williams.

THE FORCE AND MOMENT ON AN OSCILLATING AEROFOIL. By H. Glauert, M.A. Presented by the Director of Scientific Research, Air Ministry. R. & M. No. 1242 (Ae. 397). (17 pages and 6 diagrams.) March, 1929. Price 9*d*. net.

The general equations for the force and moment on a cylindrical body in any accelerated motion have been developed in R. & M. 1215* with the restriction that the circulation round the body remains constant, and the lift and pitching moment of an aerofoil due to a uniform angular velocity of pitch have been calculated in R. & M. 1216.† The analysis has now been extended to the more general problem when the circulation round the body also varies.

The general equations for the force and moment on a body with varying circulation have been developed and applied to the problem of a straight line aerofoil performing a steady angular oscillation.

The lift and pitching moment, due to the angular velocity in the oscillation, are shown to be independent of the angle of incidence, but to vary rapidly with the position of the centre of rotation and sometimes with the frequency of oscillation. At very small frequencies the damping moment is found to be unstable if the centre of rotation is in the front quarter of the chord.

As a test of the theoretical conclusions, further experiments on the damping moment of an aerofoil would be valuable, investigating in particular the effects of the position of the centre of rotation and of very low frequency of oscillation.

* R. & M. 1215. The accelerated motion of a cylindrical body through a fluid.—Glauert.
† R. & M. 1216. The lift and pitching moment of an aerofoil due to a uniform angular velocity of pitch.

WIND TUNNEL TESTS ON A SYMMETRICAL AEROFOIL (GÖTTINGEN 429 SECTION). By W. G. A. PERRING, R.N.C. Presented by the Director of Scientific Research, Air Ministry. R. & M. No. 1243 (Ae. 398). (4 pages and 4 diagrams.) February, 1929. Price 4*d*. net.

The lift has been measured over a range of incidence, at tunnel speeds of 60, 80 and 134 ft./sec. respectively. The results corrected for tunnel interference and reduced to infinite aspect ratio have been compared with similar tests on an aerofoil of the same section carried out in the Duplex Tunnel at the N.P.L. and with Göttingen tests.

In general the R.A.E. and N.P.L. tests give about the same value of maximum lift coefficient at the same Reynolds number, but the shapes of the curves differ considerably, particularly after the stall.

THE INFLUENCE OF OXYGEN ON CORROSION FATIGUE. By A. M. Binnie, M.A. Presented by Prof. C. F. Jenkin. Work performed for the Department of Scientific and Industrial Research. R. & M. 1244 (M. 63). (3 pages and 9 diagrams.) March, 1929. Price 6*d*. net.

The experiments described below were carried out in the Engineering Laboratory at Oxford, at the request of the Aeronautical Research Committee, to determine to what extent the reduction of the fatigue limit of certain steels by corrosion is due to the presence of oxygen in the surrounding atmosphere.

Previous work on corrosion fatigue has been done by McAdam, at Annapolis, and by Lehmann,* at Oxford, but both these experimenters used specimens immersed completely in a liquid.

The fatigue limit in air of 0·9 carbon acid steel was found to be 17 tons per sq. in. When a strong solution of common salt was allowed to drip in air on to the point of maximum stress in the specimen, the fatigue limit was reduced to 7·5 tons per sq. in. The repetition of these latter tests in an atmosphere of commercial hydrogen gave a fatigue limit of 9·1 tons per sq. in.

The corresponding figures for 0·33 carbon steel were found to be 18·3, 9·2, 11·8 tons per sq. in., specially purified hydrogen being used.

* R. & M. 1054. The variation in the fatigue strength of metals when tested in the presence of different liquids. G. D. Lehmann. R. & M. 1222. High-Frequency Fatigue.—G. D. Lehmann.

MEASUREMENT OF LANDING LOADS. By E. T. Jones, M.Eng. (Presented by the Director of Scientific Research, Air Ministry.) R. & M. No. 1246. (Ae. 399.) (8 pages and 5 diagrams.) April, 1929. Price 9*d*. net.

Except for the undercarriage which was of special construction, the aeroplane used in the experiments was the standard D.H. 9 fitted with a 260 h.p. Fiat engine. The undercarriage was robust in design to cope with the stresses associated with fairly bad landings, and provision was made within the undercarriage itself for recording the landing loads.

Various types of landings, from good to severe, were made with and without drift to both port and starboard on a D.H. 9 aeroplane at constant loading. Measurements were made in each landing of the vertical longitudinal and lateral loads and of the vertical and drift velocities. A taxying test was also made for about 150 yards at a ground speed not exceeding 30 m.p.h.

The maximum vertical velocity recorded in a landing made purposely severe was 9·3 ft. per sec., and the maximum vertical reaction was 4·1 W. The maximum longitudinal and lateral loads were incurred during the same landing, and were approximately 1·4 W. and 0·8 W. respectively. The values of the maximum vertical, longitudinal and lateral loads while taxying on Farnborough aerodrome were 3·1 W., 0·65 W., and 0·6 W. respectively, and were comparable with the loads in all but very severe landings.

For average ground hardness it appears that only half the energy at impact is absorbed by the undercarriage structure, the remainder is absorbed by the tyres, the ground, and the aircraft structure for undercarriages of the type used in these experiments.

AIR TRANSPORT

COMMANDER BYRD'S NEW-TYPE COMPASS

MAGNETIC disturbances at the South Pole precluded the possibility of accurate navigation, and forced Commander R. E. Byrd to use the Bumstead sun compass during the greater portion of his recent flight, according to Charles H. Colvin, President of the Pioneer Instrument Company, who supplied all the navigation equipment used by Byrd.

To establish an absolute course, Byrd carried with him, also, the conventional magnetic compass and an earth inductor. Both units, however, while retaining their accuracy at all times, became less and less sensitive upon approaching the Pole, on account of the decreasing ratio of influence.

The sun compass, however, which is like a clock with a single hand moving at the same speed as the earth about the sun, solved the problem, and ignored the time-honoured magnetic pole. The face of the clock bears the usual hour divisions. The tip of the hand carries a needle, and the base bears a screen marked with perpendicular lines. The sun casts a shadow of the pin on the screen.

Before starting from Little America, Commander Byrd set the hand of the clock at true solar time. He turned the entire instrument until it read due south, as indicated by the compass markings on the base plate. Then he moved the latitude scale and set it at 90°, the location of the Pole. When he took off, he swung the plane until the sun cast the shadow of the pin between the lines of the screen, where it was held until the goal was reached.

Inasmuch as the hand of the clock makes one revolution in 24 hrs., and the earth makes one complete revolution in the same time, the compass and the hand of the clock remained in a constant relative position, so that a straight line might be maintained.

When Commander Byrd reached the South Pole and turned for his base, he rotated the base plate until it read north, instead of south, and the airplane was again directed to bring the shadow of the pin back on the screen again.

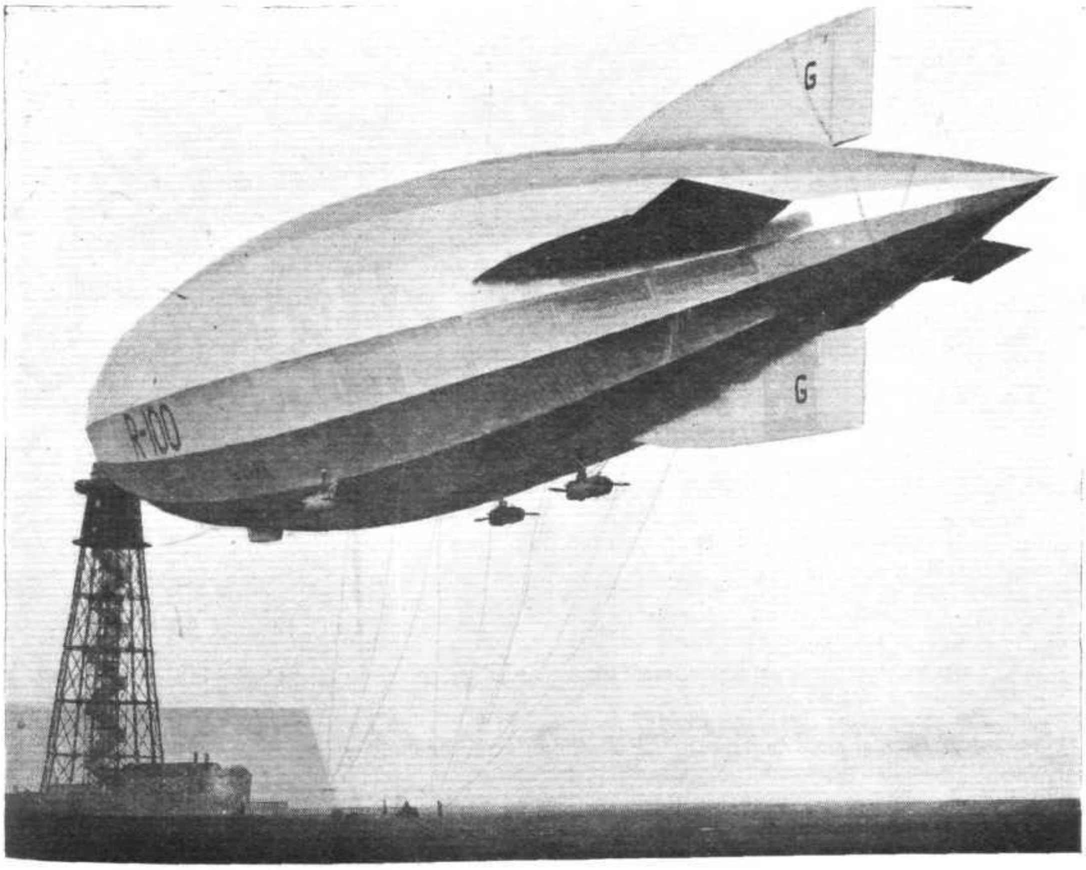
If, at any time, clouds obscured the sun, he depended upon the earth inductor, which is an instrument comprised of three units: one reacts with the earth's field, and therefore corresponds to the magnets of an ordinary compass; the second is a direction controller, and the third is a steering indicator. The generator produces an electrical potential by reaction with the earth's magnetic field, the potential dependent upon the angle at which the brushes of the generator are set. The direction controller consists of a compass face which may be set by a crank. Thereafter, so long as the 'plane continues in the direction set, the needle on the steering indicator continues to point to zero.

In addition to the compasses, Commander Byrd had a turn and bank indicator for level flight, a rate of climb indicator, an altimeter, an air speed indicator, oil temperature indicators for each of the motors, tachometers, oil-pressure gauges, fuel flow meter, and fuel pressure gauge.

President Hoover signed a Bill on December 21 raising Comdr. Byrd to the rank of Rear-Admiral on the retired list of the United States Navy in recognition of his "extensive scientific investigations and extraordinary aerial explorations of the Antarctic Continent and of the first mapping of the South Pole and the Polar plateau by air."

The Bill, which passed the Senate on Friday, had been voted with applause by the House of Representatives. The rank and pay of $4,500 (£900) yearly become effective immediately.

Rear-Admiral Byrd received his previous promotion to commander also by Act of Congress after his flight over the North Pole. Having skipped the rank of captain, he is now, at 41, the youngest Rear-Admiral on the list.



R 100 at the Cardington mast.
(FLIGHT *Photo.*)

Unsubsidised Aircraft Operation in Canada

SINCE its inception on Christmas Day, 1926, Western Canada Airways, without subsidy from any Government department, has increased and expanded as a purely commercial concern, relying entirely on the goodwill created among the mining fraternity and the travelling public generally, who stand in need of fast transportation in the execution of their business.

The figures appended give a graphic picture of the appeal which speed in transportation has made to the mining men of Northern Canada in the past three years :—

Year	Hours	Miles	Passengers	Express	Mail
1927	1902·21	145,834	1,747	420,730 lbs.	Nil (lbs.)
1928	6873·30	545,193	9,648	1,192,646	132,140
1929 (to Nov.)	8132·48	701,995	11,394	1,523,676	229,342
Total to date	16910·39	1,393,022	22,789	3,137,052	361,482

Speeding up the Luft Hansa

FLYING time between London and Berlin and Berlin and Paris will in future be reduced by one hour. A new service will be opened in the summer of 1930 between Prague and London.

A German Tragedy

THE German Luft Hansa pilots, Herren von Schröder and Albrecht, who, with their mechanic Eichentopf, had recently made fast experimental research flights to Seville and Constantinople in preparation for the contemplated long-distance air-mail services, were killed on December 19 in an accident near Neu-Ruppin, about 30 miles from Berlin, on their return from the Canary Islands. It is reported that they lost their way in a fog, and either in descending to try to find their position, or in attempting to land, one wing of their aeroplane (an Arado V-1 monoplane with a 500 h.p. B.M.W. "Hornet" engine) hit the ground, and the machine crashed. Herr Eichentopf was only slightly hurt, and was able to drag his companions out of the machine, but Herr von Schröder was already dead, and Herr Albrecht was so seriously hurt that he died soon afterwards.

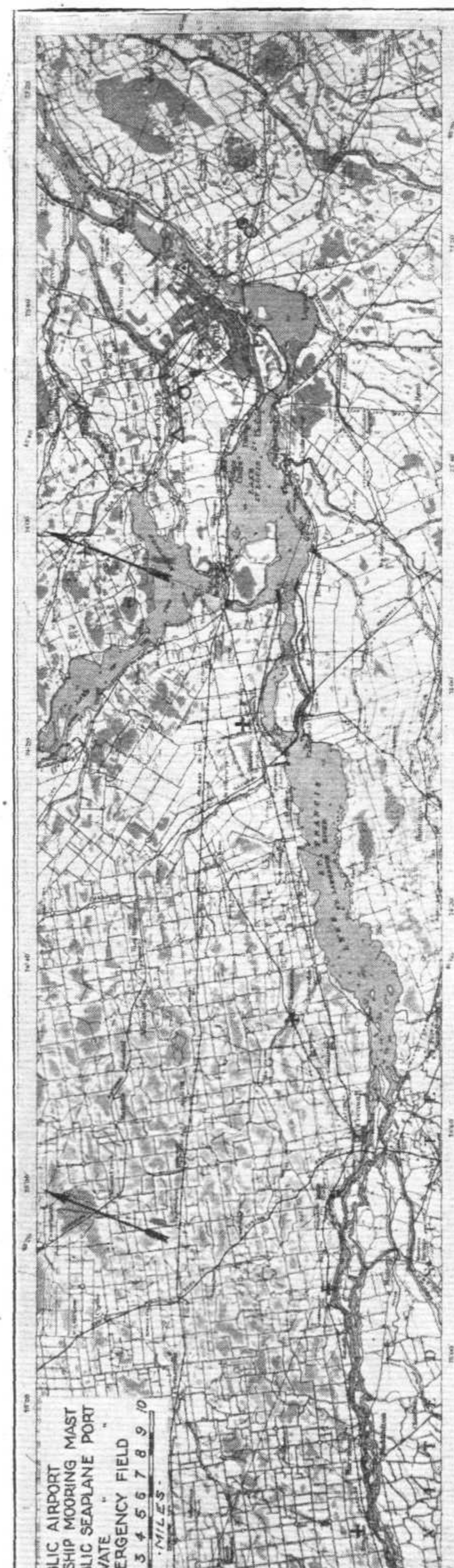
Improved European Air Services

REPRESENTATIVES of 22 European airway companies have been holding in Berlin, under the chairmanship of Herr Wronsky, of the Deutsche Lufthansa, the annual meeting for the drafting of next year's international airway time-table. A proposal put forward by the Lufthansa was accepted in principle, that the summer time-table should apply throughout Europe from May 1 to August 31, the intermediate autumn time-table from September 1 to October 31, and the winter time-table from November 1 to February 28. Among the improvements decided on for 1930 is a reduction by one hour of the time taken by the regular Berlin-London and Berlin-Paris passenger services. Although the principle of co-operation continues to govern the arrangement of international airways, and indeed has prevailed more effectively than ever at this year's conference, opportunities for healthy competition have been agreed upon in a number of cases.

Among the new lines planned for 1930 are a day service from Oslo, *via* Berlin and Vienna, to Budapest, and a Berlin–Vienna–Belgrade line, which is to be extended before long to Uskub and Salonika. Direct communications to Paris, London and Rotterdam *via* Lyons are to be provided for passengers from Barcelona. Further agreements have been reached for the extension of Sunday flying services. The Lufthansa's air mail services from Berlin to Paris and London will be arranged so that letters posted in the evening are delivered the next morning. As a result of the recent experimental flights the Lufthansa is contemplating combined air and railway services from Berlin to Constantinople, using the Gleiwitz or the Vienna night express trains, and to Seville, using the Berlin–Stuttgart night express.

R 100

ON December 18 the airship R 100 was moved from the tower at Cardington into the second shed at that air station. Adjustments will be made in the shed to the outer cover of the hull and the lower vertical fin, which had not remained taut when exposed to the slipstream from the rear engine car. Now that both airships are in their sheds it will be possible to reduce the number of men on duty to a minimum, and to grant Christmas leave to a number who would have had to remain on duty if one of the airships had been moored to the tower.



A new Aviation Map, Montreal to Morrisburg, issued by the Canadian Government. The original, printed in colours, measures 9 ins. × 36 ins.

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CORRESPONDENCE

[The Editor does not hold himself responsible for opinions expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters intended for insertion in these columns.]

RETURNS FOR SUBSIDIES

[**2252**] You mention in your editorial that it is questionable whether the Air Lines show any return for the subsidy expended. Surely this is not so. However, it would be a simple matter for Imperial Airways to appeal to all those that have travelled, sent goods or mails by air, to render an approximate statement of the value of any orders obtained or any saving made through the use of the subsidised aircraft. Messrs. Tata have evidently reaped some benefit.

V. D. DICKINSON,
AERO HIRE, LTD.

Castle Bromwich, Birmingham.
December 14, 1929.

MODEL AIRCRAFT

[**2253**] I have been looking through past volumes of FLIGHT in order to find out whether you gave any space to either scale or flying model aircraft.

In 1923 you published a weekly report of the doings of the Society of Model Aeronautical Engineers, and an interesting article on "Power Plants for Model Aircraft," and quite recently a short article on scale models. This latter article prompts me to write this letter.

I believe, also, that you had a regular feature headed "Models" in earlier years than 1923.

Since you accept regular advertising matter from those who provide models, and material for making the same, I should be very pleased to see the revival of articles on scale and flying model aircraft, as a regular weekly feature.

As I am keenly interested in all sections of aviation, from full-size machines to models, I am wondering if other readers of your valuable journal would also welcome regular contributions to this section of aeronautical work.

I should be glad to see the views of your readers on this subject in further issues of FLIGHT.

NORMAN E. NEVILLE

Fareham, Hants.
December 16, 1929.

A GRIEVANCE

[**2254**] May I venture in haste to reply to Mr. Crosse's letter in your correspondence columns of your last issue.

Does not the gentleman concerned realise that there are hundreds of "chaps" like himself who are similarly qualified, and yet this is the first letter of its kind that I have ever noticed in any journal devoted to aircraft.

It seems the only possible way of solving the problem is to waste more of our amiable Government's (incidentally our) money in endeavouring to instal a further amount of air-mindedness necessary to obtain a "B" licence, which, of course, is the only ticket recognised by aircraft firms as being of genuine worth.

I was once in his position in the Royal Air Force, and am now in possession of ground engineer's tickets, which, although of less exalted prominence, are albeit none the less necessary in civil aviation.

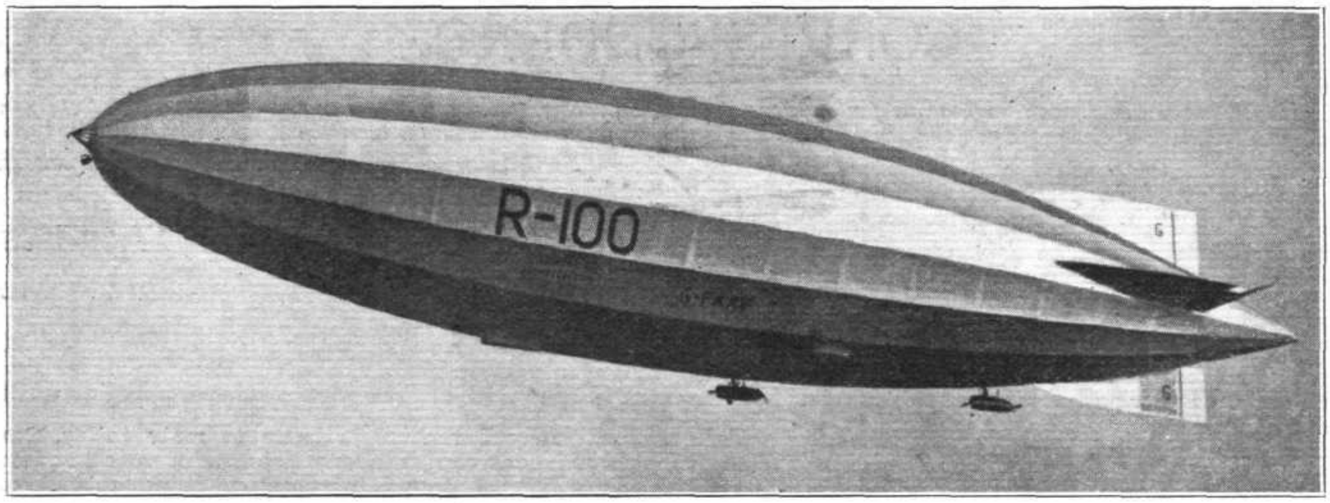
As a "tip from the horse's mouth," may I advise your correspondent before reaching for the stars first to consider who is to foot the bill.

From an old reader,
H. BROWN

Coventry.
December 14, 1929

UN-NATURAL HISTORY

Irate Professor: "Confound it, Sir! Do you realise you have made me lose a very valuable Moth?"



FLIGHT *Photo.*

"THE AIRSHIP R 100"

[*A Report on a Lecture on Thursday, December* 5, 1929, *before the Westland Aircraft Society, at Yeovil, by Mr. R. B. Brigham, A.R.Ae.S.* (*late Assistant Chief Inspector at Howden, now Chief Inspector at Westland Aircraft Works*)]

THE lecturer, who was introduced by Mr. R. A. Bruce, President of the Westland Aircraft Society, opened with a brief and general description of the airship R 100, which has an overall length of 709 ft. and a diameter of 133 ft., with a cubic capacity of 5,250,000 cub. ft. She carries three power cars, each with two engines, and the lecturer pointed out with the aid of a slide that these cars were situated at a considerable distance fore and aft from the passenger accommodation, and there was therefore a minimum of noise and vibration in the latter. To give an idea of the size of the main fins Mr. Brigham pointed out that each one of these had an area about equal to that of the drawing office of the Westland Aircraft Works. The ship contained some 11 miles of special spiral seam tubing. Her displacement was 156 tons. In the "Graf Zeppelin" the cross-sectional area of the girders equalled some 12 sq. in., whereas in the British ship the cross-sectional area amounted to 3 sq. ft.

There were 16 main longitudinals and 16 transverse frames, and Mr. Brigham described the making of the spiral strip duralumin tube girders, of which these were largely constructed. They had first thought of using solid drawn tubes, but they at once realised the impossibility of obtaining these in lengths of from 50 to 60 ft., to the necessary fine limits at anything like a reasonable price, in addition to which there was the difficulty of transit. Mr. B. N. Wallace designed a special machine for making the spiral girders from duralumin strips 11 in. wide to 60 ft. long and 0·056 in. thick, for the main girders. Other girders were made from material 0·032 in. for the thinnest and 0·64 in. for the thickest. The first operation was to joggle the edge and the strips were then fed into rollers and coiled on to a mandrel. Two compressed air drills made the holes for the rivets at the correct pitch and rivets were inserted at about every 6 in. to hold the spiral in position. The actual complete riveting was carried out on special machines operated by unskilled labour. The tubes were placed on a bar some 20 to 25 ft. long through the centre of which the rivets were fed through a copper tube by compressed air. The rivets were fed into the holes and then closed on a suitable recess in the bar.

Taking the construction of the ship in greater detail, the lecturer proceeded to describe the building up of the main bracing. The girders were built up from three large tubes 25 ft. long for the transverse members and 45 ft. long to 50 ft. long for the longitudinal members. They were built up in wooden jigs, the three tubes being arranged at the corners of an equilateral triangle and braced together by members formed of pressed duralumin. These struts were first held in position by 2 B.A. bolts, and then finally riveted. The main bracing girders formed the main frames of the ship and at the junction of the transverse and longitudinal girders was a fitting which they called the main joint and which was one of the finest pieces of engineering work in the whole ship. It consisted of two "spiders" each with three arms for taking the three tubes of the main girders, one spider for the longitudinal members and the other for the transverse members. The couplings consisted of extruded duralumin tubes, the ends of which were threaded and provided with locking rings for adjustment. The main joints also provided anchorages for the many bracing wires which met at these points. There are 16 transverse girders making up each transverse ring of the ship and therefore 16 main joints and spiders.

The ring was made on the floor of the shed and was first marked out with the size and the position of the main joints shown. When the ring was complete it was hoisted to the vertical position, but before it was raised the radial bracing wires were placed in position. A main bracing wire ran from each main joint to a centre fitting and a series of catenary wires were fitted from end to end of each of the transverse members, these wires being some $\frac{5}{8}$ in. in diameter steel cables. They were anchored to Brunton's Truelock fittings, a very successful device to which as many as eight steel ropes could be anchored with a fitting not more than $2\frac{1}{2}$ in. in diameter. From the catenary wires to the centre fitting was stretched a series of $\frac{1}{8}$ in. piano wires which were left with 6 in. of slack. Finally, all these radial wires were connected up by circumferential wires, making a wire mesh netting like a spider's web. The completed ring was hauled into position by means of a main purchase from the centre of the roof and with the help of various tail ropes hitched on to the main joints. When several frames were in position the work of inserting the longitudinals could proceed. Work was carried on largely with the aid of fire-escapes and boatswains' chairs. In order to accommodate the corridor in the bottom section of the rings, the catenary wire was allowed to form a different shape in this section.

The adjustments of the structure was made by means of the coupling nuts of the main joints, which were something similar to ordinary pipe joints, with left- and right-hand threads. They had found that with the aid of a little lanoline on these threaded joints no trouble was experienced in making the necessary fine adjustments. There was only a $\frac{1}{4}$-in. diameter tolerance on the rings, which were 133 ft. in diameter.

One of the slides depicting the rings resting on small trestles on the floor before erection showed a series of 56 lb. weights. The lecturer explained that these were used for proof-loading the frames. The main longitudinal girders were crossed braced with shear wires, which were actually from $\frac{3}{8}$ in. to $\frac{3}{4}$ in. diameter steel ropes. These shear wires were, however, not subjected to any initial tension, and in view of the impossibility of applying a tension meter of the usual kind to wires of this size they were pulled together by means of a special apparatus which indicated the actual load on the wires, after which the usual style of turnbuckle was inserted. The mesh wiring of the rings, including the main radials and the catenaries with the piano wire netting served to keep the gas bags in position in a fore-and-aft direction. The longitudinal members were also interspersed with wire mesh for a similar purpose.

Right through the centre of the ship was an axial girder. This girder ran through the inside of the gas bags, which


"GADZOOKS! A MOTH FORSOOTH"

were provided with a tunnel surrounding the girder, and this member not only served to connect up the fin structures, which were described later, but was also of great assistance in erecting the gas bags. Whereas, when they were building the R 33, if three men were seen together on one joint, there was liable to be trouble, it was often necessary for 18 to 20 men to be along one girder in the course of the building of the R 100, and this gave an idea of the relative strengths of the two ships.

Work was reached by means of ladders down from the roof and round the frames. A cat-walk along the top of the ship some 9 in. wide only, was of great assistance in enabling the men to move about, and they soon became accustomed to walking along this cat-walk at a great height in the air. If one was careless enough to fall off, one was not allowed to go up again!

The sections of wire mesh, which encased the ship, were built up on the floor of the shed in segments; each of these segments formed a shape, which when developed formed part of the surface of a cone, corresponding with the taper of one portion of the ship, and when complete the section of wiring was wrapped round the ship and finally anchored in position. Thus the whole ship was covered with a wire mesh of about 1 ft. between wires.

A great point in the construction of the R 100 was that from ring 4 to ring 12 aft all the longitudinal girders were interchangeable, both as regards length and curvatures, and were built on the same jigs.

Describing next the structure of the fins, Mr. Brigham showed how these were first built up on the floor of two bays of the shed. Such large surfaces could not be just tacked on to the outside of the ship, and an internal structure was necessary to carry them. This structure took the form of cruciform or starfish girders, which ran right through the rear of the ship, the two horizontal and two vertical girders met in the form of a cross in the centre of the ship, where they tied with the axial girder running from forward right aft. The starfish girders formed a rigid frame crossing the main structure at rings 13, 14 and 15.

As distinct from aeroplane practice, the fabric used was not doped after being stretched in position, but consisted of ready rubberised fabric, which was stretched into position by a series of flax cords. When the seams were brought together they were covered with sealing strips and this method gave rise to the appearance of stripes which had been noted on the R 101. The fin surfaces were covered by zig-zag wiring and the fins were anchored to the main structure by a series of streamline wires, which wires were coupled to ropes running round the ship, and the fins were thus anchored to the structure by these wires only.

The elevators and rudders were balanced, and were operated by means of four small variable gear boxes. The ratio of the gears varied from 30 to 1 to 300 to 1, and the gear was of the eccentric type, consisting of a heart-shaped pinion and curved racks.

In spite of the enormous sizes of the control surfaces, the control cables were only 10 to 15-cwt. cables, *i.e.*, smaller cables than were used in aeroplanes. These cables were operated from a steering engine in the control car, and only required a pressure of some 4 lb. on the hand wheel in order to move the surface through some 30°. The main control wheels were about 4 ft. in diameter, and so light has the mechanism proved in operation that the weight of 2 lb. on the spokes was sufficient to revolve the wheels and operate the controls. The surfaces were returned to normal by means of long springs anchored to the inside of the fins.

The R 100 was the first ship built which incorporated the system of ventilators to relieve the internal pressure on the gas bags. He recalled that the accident to the Shenandoah was caused through the ship being unable to get rid of the superfluous gas due to sudden expansion through the normal gas valves, and it was expected that the new system of ventilation, by means of which air was admitted to the interior of the ship by means of gauze windows would obviate this difficulty, as the internal pressure would be equal to the external pressure of the atmosphere.

Returning to the description of the gas bags, the lecturer showed a slide in which the gas bags were shown slung up on the axial girder. They had to be placed in position during the building of the ship, and had been in place some twelve months before the ship was completed. Some of the bags weighed as much as a ton each, they were 133 ft. in diameter and 40 ft. long, and thus the work of inflation was by no means a simple one.

The passengers enter the R 100 through a door in the nose of the ship, and the gangway was enclosed in a canopy. This was a considerable improvement over the entrance provided into the R 101 from the mooring mast, which was quite open, and the sensation of being in mid-air at that height was apt to prove rather emotional to the passengers.

The passenger saloon was slung from the main joints of the ship, and seated some 50 people comfortably. There was not room to seat 100 together, so 50 were seated at a time. Mr. Brigham then described the passenger accommodation, and the electric kitchens provided; from the saloon, with its polished mahogany veneer pillars and 5-ply birch floor, which was polished and carpeted, staircases led up to the cabins and down to the control car. The passengers' cabins were arranged round the saloon and on the upper deck. The cabins were either two-bunk or four-bunk. Lavatories and ablution arrangements were situated forward. A majority of the fittings were of balsa wood, and the ship was lighted and heated electrically. The heater elements were arranged to be placed in any position where there was a draught, the only position in which they were of any use.

The wiring system had received particular care and attention with a view to eliminating any possibility of sparking. The majority of the cables were ½-in. diameter braided aluminium, carrying current at 220 volts, and so designed that if by any chance a cable should be cut no sparking would take place. The Metropolitan-Vickers Co. had designed special fittings which were quite gas-tight, and although rather bulky they obviated the danger of sparking due to possible breakages. The passenger saloon was decorated with fire-proof distemper.

The passengers were not allowed aft, and, indeed, they would not wish to pass along the 12 in. cat-walk, which was the means of communication aft, and they were allowed forward. Mr. Brigham said that he did not think there would be any cases of air sickness, as there would be no rolling motion on such a ship.

Describing the engine cars, the lecturer explained that the engines were Rolls-Royce Condors of 650 h.p. each, placed back to back in the power cars, one driving a tractor and the other driving a pusher air-screw. A gas starter was provided in the car and the aft engine was provided with a gear box which allowed for reverse running. The gear-box itself weighs some 300 lb. The propellers were 17 ft. in diameter. The radiators, which were the largest radiators ever built in this country, were made retractable to suit the climate in which the ship was flying. Pott's oil coolers were fitted, and proved very satisfactory. In each of the two wing cars were installed A.C. motor-car engines of 60 b.h.p., direct coupled to D.C. dynamos for providing the current for lighting and heating. Each car weighed about 2½ tons. The three cars, therefore, weighed 7½ tons in all, which compared with some 22 tons in the case of the R 101. The power cars were connected to the main joints of the ship by four compression struts, and also by drag and anti-drag wires. Access to the cars from the ship was by means of a specially-designed streamline ladder. Closed companion ways from the cars into the body of the ship were prohibited on account of the possible danger from fire. The air flowing between the power car and the ship was supposed to form a fireproof bulkhead. The streamline ladders mentioned were about 21 in. wide by 6 in. across when closed, and when opened formed a partly protected means of communication. The car accommodated six people in reasonable comfort, and work was possible on the engines when the ship was in flight. The car was a simple structure, composed of square girder work with plate coverings.

In the control car were the large control wheels for operating the elevators and rudders, and also the wireless apparatus, including a very complete directional set. Alongside the control car were handling rails, and the car itself was built on to the passenger saloon, which was reached by a staircase. In the car were the controls for operating the water ballast, the manœuvring valves, the ship's telegraphs to the engineers in the power cars, etc. There were 18 water ballast bags provided, each with a capacity of 1 ton. Four bags were situated at frame three, ten at the control car and four at frame twelve. The controls to the various stations were taken through fairleads, and springs were inserted to take up any stretch as it developed. The main control wheels for the elevators and rudders were provided with a declutching device, and transmitted motion to the steering engine, which really consisted of a reduction gearing by means of a chain running on sprockets.

The gas bags themselves, of which there were sixteen, had a double covering, the exterior one of Egyptian cotton, and the interior one of goldbeater's skin. The lecturer explained that the growth of the goldbeater's skin caused the gas bag to be sealed perfectly after it had been made up. The exterior fabric covering of the ship, as already described,

was of rubberised fabric, and had a tensile strength of 40 lb. to the inch. The covering was not pulled quite taut, but was anchored to the wires by means of L-tapes, and was allowed to sag when stretched between two points in order to the better take the load.

Describing the method of mooring, the lecturer explained that a 700 ft. steel hawser was first dropped from the winch mooring platform forward, when the ship was flying at a height of 400 ft. The forward engines were run throttled down, and the rear engines were placed in reverse. A cable was paid out from the mast and connected up to the mooring cable of the ship, which was then hauled in. Side ropes were run out to help guide the ship up to the mast, and she was eventually hauled in and attached to the mast by means of a bucket-shaped structure on the nose, known as the dew-drop. The mooring gear was designed to withstand a gale of 100 m.p.h.

Describing the method of trimming the ship in flight, the lecturer explained that the ship would trim better at night owing to more even temperatures. Rain also upset the stability of the airship, and trim had to be maintained by the release of water ballast or by use of the manœuvring valves. The gas bags were not filled completely full, but to some 80 per cent. of their full capacity to allow for expansion in high temperatures.

Mr. Brigham illustrated his points by means of drawings and lantern slides, and although he explained that he was not a lecturer, and did not lecture, he nevertheless proved himself to be a lecturer of the first class, extremely clear in his description and explanations, and maintaining a logical sequence throughout his entertaining paper.

A number of very interesting questions were ably answered by Mr. Brigham. Mr. R. A. Bruce asked regarding the extent to which anodising treatment was used on the R 100. The lecturer replied that it was impossible to anodise the long tubes of 40 ft. to 50 ft. in length, and these had been carefully treated with Pinchin and Johnson varnish, which had proved fairly effective against corrosion. Some slight cases of corrosion had been noted, probably due to the humidity of the atmosphere in the shed, which was below sea-level, but such difficulties had been got over by re-varnishing. Pulley and other small parts had been treated by anodising.

A member asked how the alignment of the hull was checked during erection, and Mr. Brigham explained that this was done by means of a theodolite erected on a platform and pointed at targets on the main joints. By this means the alignment of the complete ship in a fore-and-aft direction was trued to within ⅛ in. In a total length of 709 ft. the truing up was facilitated by means of the joints with the screwed nuts already mentioned. These nuts were provided with a series of holes drilled round their periphery, which allowed fine adjustments to be made readily. The shear ropes were not used in truing up the structure in any way.

Mr. R. A. Bruce asked whether they had had any trouble with expansion, due to local temperature conditions. Mr. Brigham replied that they had had such trouble on hot days, where the expansion of the shed was more than that of the ship. Owing to the expansion of the roof trusses, they were continually having to pull the members into alignment.

Capt. Hill asked whether there were any adjustments provided on the lengths of the struts. The lecturer replied that no adjustment was provided, and also mentioned in passing, that the 18-ton wire used in the shear wires was only loaded to 0·6 of a ton.

The question was asked as to whether the 700-ft. long control wires did not present some difficulty in their operation. Mr. Brigham replied that the system was tried out first on the ground, and that the gear box solved the difficulty. Backlash was taken up by springs. The gear boxes, which were not operated by power, but by the large hand wheels in the control car, and the use of such light cables, was made possible by the large reduction in the gearing, namely, 300 to 1. The main control wheels make a large number of turns in moving the elevators through 30°, and the time taken for such elevators would be in the neighbourhood of 30 sec. The steering engine itself merely consisted of a reduction gear.

Reverting to the question of corrosion, Mr. Bruce enquired whether their difficulties had proved serious in this connection. Mr. Brigham replied that the varnishing had proved successful. In spite of the criticisms levied by "Mr. Spanner" in his articles, the girders had been provided with small inspection patches, and by means of the use of a small looking glass and a light, the interior of the girders could be inspected for corrosion.

Another member asked how the ship was held down after it had been taken in the shed, and Mr. Brigham explained how hawsers were lowered from the mooring platform, and the machine anchored to the ground under the instruction of the coxswain on board. Underneath the cars were large bumping bags, which served as buffers or fenders to prevent the ship damaging herself against the ground.

The petrol system was so arranged that petrol could be pumped along from one portion of the ship to another to help balance the ship. Pumps were provided for effecting this transfer. The water ballast would not be so transferred along the keel of the ship. The lecturer here mentioned that the petrol tanks were made of aluminium with a joint in the centre, the material being 0·02-in. thick. Each tank carried one ton of fuel, and weighed 82 lbs. It was provided with rather an elaborate internal structure of duralumin metal plates and steel tubes, specially designed to prevent the tank from bulging or distortion of any kind.

In answer to a further question regarding the method employed for showing the amount of fuel in the tanks, the lecturer replied that the coxswain had to keep a careful eye on the contents of the tanks, and it should be remembered that the consumption amounted to about 1 ton per hour. There was a tell-tale on each tank, operated by a floating ball and lever. The petrol pipes were of aluminium throughout, and it would be interesting to watch the results obtained. In the R 101 the aluminium pipes had been replaced by pipes of copper.

In reply to yet another question, Mr. Brigham stated that the structure weight of the R 100 was greatly superior to the structure weight of the R 101, which was built of stainless steel tubing of 2-in. diameter. Alpax castings were not used to any extent. The aluminium bollard to which the jack stays were anchored were the only castings of any size used.

In closing the meeting and thanking the lecturer Mr. R. A. Bruce remarked on the logical sequence of the lecture, which, he said, had been built up like the ship itself, starting from the beginning and progressing step by step in orderly fashion. One of the most interesting points from the aeroplane point of view was that referring to corrosion, and he sometimes wondered whether the amount of trouble that was taken in aeroplane work with anodic treatment, etc., was entirely justified, although the members of an aeroplane were probably subject to more accidental damage, abrasion, etc., than the members of an airship, and no doubt this abrasion would have a great effect on the corrosion which took place.

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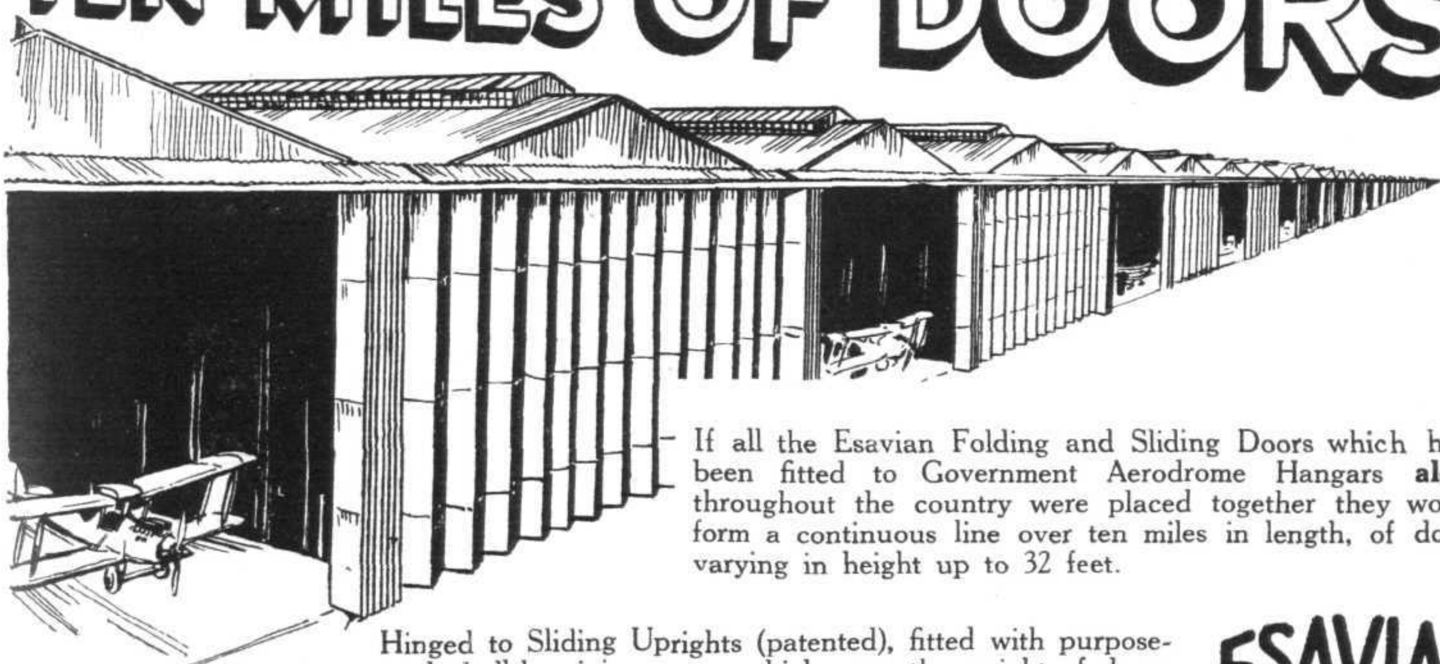
R.A.F. CASUALTIES

DURING the last four years the number of fatal crashes and deaths in the Royal Air Force have been as follows :—

	Crashes.	Deaths.
1926	54	85
1927	37	54
1928	50	76
1929	31	42

These figures are very striking. Except for the deplorable lapse in 1928, the downward tendency is a matter for great satisfaction. Several causes are at work to bring this result about. One is the use of parachutes, which in the present year saved 19 lives; but, even if those lives had not been saved, this year would still show an improvement over last year. The use of slotted wings also makes for safety. But the chief cause is ever increasing care and efficiency in methods of training. It is usually reckoned that the most dangerous period in the life of a pilot, as in that of a motorist, is when he has learnt control of his machine but has not amassed experience or acquired caution. Special attention is directed to guiding the pilot through this stage. Risky flying as apart from the daring which is necessary to service duties, is not considered admirable, and is sternly frowned upon.

It should be added that the real improvement is even greater than is shown by the figures. Not only does the performance of British aircraft increase every year, but every year more flying hours are put in. Consequently, even if the casualty figures remained the same in two consecutive years, there would be an actual improvement in the chances of long life, as an insurance company would reckon them. The reduction of casualties when combined with the other factors is doubly satisfactory.



Kindly mention "Flight" when corresponding with advertisers.

THE ROYAL AIR FORCE

London Gazette, December 17, 1929

General Duties Branch

Pilot Officer on probation T. Gadd is confirmed in rank (Nov. 1); Pilot Officer J. C. Allan is promoted to rank of Flying Officer (Nov. 25); Pilot Officer H. B. Maugham is promoted to rank of Flying Officer (Oct. 8, 1928) (substituted for *Gazette*, Aug. 13, 1929).

Air Vice-Marshal F. C. Halahan, C.M.G., C.B.E., D.S.O., M.V.O., is placed on half-pay list, scale A, Dec. 16 to Dec. 31 inclusive; Wing Commander E. R. Manning, D.S.O., M.C., is placed on half-pay list, scale B, Dec. 14, 1929, to March 31, 1930, inclusive; Flight-Lt. A. Ferris is placed on retired list (Nov. 28); Flight-Lt. E. S. C. Vaughan, M.C., is placed on retired list on account of ill-health (Dec. 17). Flying Officer J. H. Parry is transferred to Reserve Class C (Dec. 18); Flying Officer B. C. Mason is transferred to Reserve, Class C (Dec. 9). (Substituted for *Gazette*, Dec. 10.) Pilot Officer on probation D. I. Carlyle relinquishes his short service commn. on account of ill-health (Dec. 18); Lt. C. B. Tidd, R.N., Flying Officer, R.A.F., ceases to be attached to R.A.F. on return to Naval duty (Dec. 3).

Accountant Branch

Squadron Leader E. W. Gregory, M.C., continues on half-pay, scale A, during the period Nov. 5 to Dec. 17 inclusive; Squadron Leader E. W. Gregory, M.C., is placed on retired list on account of ill-health (Dec. 18).

Medical Branch

W. J. Cotter, M.B., B.Ch., is granted a temp. commn. as Flying Officer with effect from and with seniority of Nov. 26; Flying Officer B. A. Porritt M.B., is transferred to Reserve, Class Di. (Nov. 27).

Chaplains Branch

The Rev. J. Black, O.B.E., M.A., is promoted to relative rank of Wing Commander (Dec. 1).

Memoranda

316541 Cadet D. H. Dawson is granted an honorary commn. as Sec. Lt. with effect from date of his demobilisation; the permission granted to Sec. Lt. G. A. Evans to retain his rank is withdrawn on his enlistment in the Army (Nov. 26).

RESERVE OF AIR FORCE OFFICERS

General Duties Branch

The following Pilot Officers are promoted to rank of Flying Officer:—A. N. Spottiswoode (Sept. 27); G. R. M. Garratt (Dec. 14); G. Williams (Dec. 15). Flying Officer L. W. Van Oppen is transferred from Class A to Class C (Nov. 15). The following are transferred from Class C to Class A:—Flight-Lt. A. Haines (Dec. 17); Flying Officer G. Rose (Oct. 23).

The following Flying Officers relinquish their commns. on completion of service:—F. L. Hudson (Aug. 29); H. Shaw (Dec. 7). Pilot Officer E. F. Briscoe relinquishes his commn. on account of ill-health and is permitted to retain his rank (Dec. 18); Pilot Officer G. Leggatt resigns his commn. (Oct. 24).

ROYAL AIR FORCE INTELLIGENCE

Appointments.—The following appointments in the Royal Air Force are notified:—

General Duties Branch

Air Commodore A. M. Longmore, C.B., D.S.O., to H.Q., R.A.F., Cranwell, on appointment as Air Officer Commanding, 16.12.29.

Group Captain R. J. Bone, C.B.E., D.S.O., to Special Duty List, on appointment as Air Attaché, Paris, 2.12.29.

Squadron-Leaders: The Hon. R. A. Cochrane, A.F.C., to R.A.F. Staff College, Andover, 14.11.29. C. B. Dalison, A.F.C., to No. 3 Flying Training Sch., Grantham, 9.12.29. J. W. B. Grigson, D.S.O., D.F.C., to R.A.F. Depot, Uxbridge, 14.11.29. H. J. Roach, A.F.C., to R.A.F. Depot, Uxbridge, 2.11.29. G. W. Bentley, D.F.C., to No. 203 Sqdn., Iraq, 7.12.29. A. McR. Moffatt, to R.A.F. Depot, Uxbridge, 1.12.29.

Flight-Lieutenants: E. Thornton, to No. 43 Sqdn., Tangmere, 9.11.29. E. C. Barlow, to Central Flying Sch., Wittering, 12.12.29. C. B. R. Pelly, to H.Q., Fighting Area, Uxbridge, 9.11.29. D. L. Thomson, to No. 111 Sqdn., Hornchurch, 9.11.29. C. W. Attwood, to Wireless Station, Ismailia, Egypt, 6.12.29. J. B. H. Rogers, to No. 31 Sqdn., India, 20.11.29. R. E. Bain, to No. 1 (Indian Wing) Station, India, 14.11.29. R. S. Blucke, to Aircraft Depot, India, 20.11.29. H. F. Bradley, to No. 10 Sqdn., Upper Heyford, 6.12.29. J. J. Teasdale, to Air Ministry (D. of E.), 9.12.29. R. L. R. Atcherley, to No. 23 Sqdn., Kenley, 9.12.29. A. C. Sanderson, D.F.C., to No. 41 Sqdn., Northolt, 9.11.29. H. J. Gearing, to R.A.F. Depot, Uxbridge, 19.11.29. A. F. Scroggs, to Aeroplane and Armament Experimental Estab., Martlesham Heath, 26.11.29.

Flying Officers: I. Hodgson, to No. 21 Group H.Q., West Drayton, 2.12.29. G. Lambourne, to H.Q., R.A.F., Mediterranean, 6.12.29. H. C. V. Jolleff, to No. 207 Sqdn., Bircham Newton, 9.12.29. A. G. Pickering, A.F.C., to Station H.Q., Hal Far, Malta, 1.12.29. D. M. Rees, M.B.E., to R.A.F. Depot, Uxbridge, 2.11.29. B. A. J. Crummy, to No. 58 Sqdn., Worthy Down, 2.11.29. F. Fazey, to R.A.F. Depot, Uxbridge, 2.11.29. W. E. Symonds, to Station H.Q., Manston, 4.12.29. F. W. Boggis, to R.A.F. Depot, Uxbridge, 2.11.29. C. J. Veevers, to R.A.F. Depot, Uxbridge, 9.11.29. D. J. R. Hylton, to R.A.F. Depot, Uxbridge, 9.11.29. G. Wood, to No. 100 Sqdn., Bicester, 26.11.29.

Pilot Officers: H. L. McCulloch, to No. 30 Sqdn., Iraq, 15.11.29. R. M. Messiter, to No. 84 Sqdn., Iraq, 15.11.29.

Stores Branch

Wing Commander E. J. Sayer, M.C., to R.A.F. Depot, Uxbridge, on transfer to Home Estab., 14.11.29.

Flight-Lieutenants: R. Craig, to H.Q., R.A.F., Cranwell, 19.11.29. E. H. Eldridge, to H.Q., R.A.F., Cranwell, 2.11.29. H. T. H. Copeland, to Supply and Transport Services, Iraq, 6.12.29. L. N. Sargent, to No. 10 Group H.Q., Lee-on-Solent, 25.11.29.

Flying Officers: F. C. C. B. Hichens, to No. 3 Stores Depot, Milton, 9.11.29. J. W. Mitchell, to No. 1 Stores Depot, Kidbrooke, 6.12.29. R. H. Clay, to R.A.F. Depot, Uxbridge, 18.12.29. W. A. D. Collingwood, to No. 501 Sqdn. Filton, 14.11.29.

Accountant Branch

Flight-Lieutenant H. A. Murton, to Station H.Q., Upper Heyford, 26.11.29.

Flying Officers: K. E. M. Holmes, to H.Q., Air Defence of Great Britain, Uxbridge, 2.11.29. G. Goodall, to No. 101 Sqdn., Andover, 12.12.29.

Medical Branch

Squadron-Leaders: E. A. Lumley, M.C., M.B., to No. 3 Flying Training Sch., Grantham, 10.1.30. W. G. L. Wambeek, to H.Q., Air Defence of Great Britain, Uxbridge, 20.12.29. D. G. Boddie, M.B., to R.A.F. Depot, Uxbridge, 2.11.29. C. P. Barber, to No. 2 Flying Training Sch., Digby, 15.1.30. C. T. O'Neill, O.B.E., M.B., to Aircraft Depot, India, 9.11.29. J. T. T. Forbes, to R.A.F. General Hospital, Iraq, 9.11.29.

Flight-Lieutenants: (Hon. Sqdn.-Ldr.) J. W. H. Steil, M.B., to R.A.F. Base, Calshot, 8.1.30. G. J. Hanly, M.B., to R.A.F. Depot, Uxbridge, 9.11.29. C. G. J. Nicholls, M.B., to R.A.F. Depot, Uxbridge, 9.11.29. J. D'I. Rear, to R.A.F. Depot, Uxbridge, 2.11.29. P. H. Perkins, to R.A.F. Depot, Uxbridge, 2.11.29. M. J. O'Reilly (Dental), to R.A.F. Depot, Uxbridge, 2.11.29. J. Magner, M.B., to Aircraft Depot, India, 11.11.29.

Chaplain's Branch

Rev. J. Lavin, to H.Q., Iraq Command, 29.11.29.

NAVAL APPOINTMENTS

The following appointments were made by the Admiralty yesterday:—*Lieutenants R.N., Flying Officers R.A.F.*: E. W. E. Lane, to *Marlborough* (Jan. 1), and A. A. Murray, to *Tiger* (undated).

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IN PARLIAMENT

Singapore Naval Base

MR. P. SNOWDEN, on December 17, in answer to Mr. Lambert, said the cost of the Singapore Base, under the arrangements approved by the late Government, was estimated to be approximately £11,600,000, of which approximately £9,000,000 would fall on Navy votes, £2,000,000 on Army funds, and £600,000 on Air funds. The contributions promised by the Dominion and Colonial Governments amount to £3,250,000. The balance payable by the British Exchequer would therefore be approximately £8,350,000. As has already been announced in the House, it is the policy of His Majesty's Government in the United Kingdom to slow down work on the base as far as possible, pending the results of the work of the Naval Conference; and the above estimates may require revision in consequence.

Imperial Airways, Ltd., and Air Ministry Charges

MR. MONTAGUE on December 18, in reply to Capt. Harold Balfour, said at Croydon the Air Ministry receive £7,461 per annum from Imperial Airways, Ltd., in respect of the housing of aircraft, the hire of office and other accommodation, and the use of the aerodrome. The charges at Lympne aerodrome and at Penshurst landing ground are levied at the ordinary tariff rate for each housing or landing and vary in accordance with user; for 1928 they amounted to £282 10s. in all. The charges in respect of accommodation represent the economic rental based on the capital cost of the buildings with interest on capital, maintenance, and amortisation. The charges in respect of the use of the aerodromes, which include wireless and meteorological facilities, are the ordinary tariff rates available to all users, but at Croydon these are commuted for a fixed annual payment; it would be impossible to segregate from the total cost to the Air Ministry the amount which the user of the aerodromes by Imperial Airways represents. The answer to the last part of the question is in the affirmative.

Cairo-Cape Air Services Route

MR. MONTAGUE, in reply to Rear-Admiral Sueter, said the proposals for the Cairo-Cape air route service have been agreed in principle with the various Governments concerned and have also been accepted by Imperial Airways, Ltd.; and various preparatory details for the organising of the service are in hand. The survey party has forwarded a first report, from which it appears that satisfactory arrangements have been made with regard to ground organisation within the Union of South Africa. It is expected that it will begin to be operated in June, 1930, and the latter half about six months after that.

Airships R 101 and R 100

MR. L'ESTRANGE MALONE asked the Under-Secretary of State for Air what alterations are being made to airship R 101; when she will be ready for further flights; when she will make her projected flight to India; and when the trials of airship R 100 will take place?

Mr. Montague: As regards the first part of the question, the work in progress on R 101 consists of minor modifications which the trials have shown to be desirable and practicable, such as the enlargement of the gas-bag wiring and the removal of equipment and fittings which the trials have shown not to be required. In addition, it is proposed further to increase the efficiency of the airship by the insertion of an additional bay. As regards the second and third parts, the airship will resume flying as soon as these alterations are completed; I am not, therefore, as yet in a position to give a definite date for her first flight to India. As regards the last part of the question, R 100 was flown successfully from Howden to Cardington on Monday, and her flying trials from the Cardington tower have commenced.

Aeroplanes (Flying Lifetime)

MR. PALMER asked the average flying lifetime of an aeroplane; and what are the methods employed by his Department to ensure that no aeroplanes are retained in commission to the prejudice of safe flying?

Mr. Montague: It is not possible to give a definite answer to the first part of the question. The flying lifetime of an aeroplane depends upon the type of machine, the country in which it is used, and the manner of its use and other variable factors. As regards the second part, elaborate instructions in regard to the maintenance, inspection, and testing of service aeroplanes are laid down in the King's Regulations and Air Council Instructions. They provide for a daily inspection of all machines in use, for further periodical inspections after a given number of hours' flying, and for complete overhaul or reconditioning after other stated periods. The system in force should make it impossible for any machine to be retained in commission if it has become unsafe for flying.

Aviation Statistics

MR. MONTAGUE, in reply to Sir A. Sinclair, said the only regular British air services which operate over this country are those to and from the Continent and to and from India; the latter service is a weekly one, and the others are not all on a daily basis. It would be difficult to give a figure of daily mileage flown, but the mileage of the routes operated by British commercial air lines throughout the empire is approximately 18,700 miles, of which approximately 5,800 is represented by the lines operating from Croydon (to the Continent and India) and the rest by lines in Canada, Australia and South Africa.

AIR POST STAMPS

By DOUGLAS ARMSTRONG

(Editor of "The Stamp Collector")

Indian Air Stamps

The latest additions to the Empire's air post stamps, with their striking vignette of an aeroplane flying over an Indian river scene, recall, perhaps intentionally, the fact that the first experimental air mail carried out under official auspices took place at Allahabad on February 18, 1911, when the aviator Picquet flew, with a mail of some 6,000 letters, across the Jumna from the grounds of the United Provinces Exhibition to Naini Junction, five miles distant. Although this happened more than 18 years ago, letters and cards impressed with the souvenir cachet of the "First Aerial Post" may still be picked up for a few shillings apiece excepting those bearing a photograph of the pilot in his Sommer biplane, which are worth a pound or two. The 'plane shown on the new Indian air mail stamps is, however, of a more modern pattern. To the right of the picture appears the King's head in a medallion, with the value in annas beneath. The five denominations are 3, 4, 6, 8 and 12 annas respectively, and the stamps are the product of the Government Security Printing Press at Nasik.

Tribute to Santos Dumont

A graceful tribute to the pioneer work of the famous Brazilian airman, Alberto Santos Dumont, is paid by the Government of Brazil, which has dedicated to him several of its first definitive air mail stamps now in course of emission. The subjects of these vignettes form an interesting record of the early days of aerial navigation when flight was in its infancy. The historic flight of the Santos Dumont airship "N 6" round the Eiffel Tower, on October 19, 1901, is depicted on the stamp of 200 reis, red. On the 500 reis, violet, we are shown his original biplane, "14 bis," being demonstrated before the Aero Club of France, on November 12, 1906. The aeroplane "Demoiselle," in which Santos Dumont made his first cross-country flight in 1909, appears on another of these stamps, as does also the hydroplane "Jahu." A portrait of Santos Dumont is to adorn the 5,000-reis air post stamp which has yet to be issued.

Included in the same series is a portrait of the ill-fated aviator, Auguste Severo, together with a stamp picture of the aerostat "Pax," in which he met his death during a trial flight at Paris on May 12, 1902.

Y225 Bids for Rare Air Stamp

A prominent dealer in air post stamps is advertising to buy, at £225, a fine specimen of the rarest of all official air post stamps, the "error" of the 24 cents U.S.A. 1918, with the centre printed upside-down. The stipulation is, however, that it must be mint and well centred, which the majority of specimens are not. A year or two ago this particular stamp was freely offered at £150 a time, with no takers. Even to-day, its catalogue (list) price is only £185! Which goes to show the extent to which the value of air post rarities has appreciated even within the past 12 months.

Answers to Correspondents

W. G. C. G. (Mr. Crewkerne).—The values of letters and cards carried by the First U.K. Aerial Post, between Windsor and London, in September, 1911, depend upon the colour in which they are printed and the date of use. The ordinary green or brown cards are worth only a few shillings each in the market to-day, but the "privilege" stationery, printed in Royal purple, is more scarce, and often fetches several pounds.

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Seasonal Greetings

THE Editor of FLIGHT tenders thanks and hearty reciprocation to one and all for the huge batch of Xmas Greetings to hand from all parts of the world.

And Again!

MESSRS. BURCH'S, the R.A.F. tailors, of 33, Bedford Street, Strand, tender their heartiest good wishes for a Bright and Prosperous New Year to officers of all ranks, and thanks for the generous support afforded them in the past.

A Mine of Information

A SUITABLE gift for the engineer, whether he is in practice or not, or even for the student, is Kempe's Engineers Year Book. Such is the vast amount of information contained therein that, strictly speaking, no engineer should be without one.

Valuable data and technical information can be found in it on almost every conceivable subject—far too many to mention here—but it can be safely assumed that if the matter is connected with engineering it will be dealt with in this book. For this year the aero engineering section has been greatly enlarged and aircraft and engines are dealt with at considerable length. Valuable tables and formulæ are included, which are a great help in every branch and, no one need ever be at a loss for information on any engineering subject if they possess this volume.

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PUBLICATIONS RECEIVED

U.S. National Advisory Committee for Aeronautics Technical Notes: No. 302.—A New Method for the Prediction of Airplane Performance. By E. P. Lesley and E. G. Reid. Feb., 1929. *No.* 303.—Condensed Data on the Aircraft Engines of the World. Compiled by C. S. Fliedner. April, 1929. *No.* 304.—Corrosion Embrittlement of Duralumin: V. Results of Weather Exposure Tests. By H. S. Rawdon. Feb., 1929. *No.* 305.—Ditto. VI. The Effect of Corrosion, Accompanied by Stress on the Tensile Properties of Sheet Duralumin. By H. S. Rawdon. May, 1929. *No.* 306.—Curves Showing Column Strength of Steel and Duralumin Tubing. By O. E. Ross. May, 1929. *No.* 307.—Strength of Tubing under Combined Axial and Transverse Loading. By L. B. Tuckerman, S. N. Pretrenko and C. D. Johnson. June, 1929. *No.* 308.—Pressure Distribution on a Slotted R.A.F. 31 Airfoil in the Variable Density Wind Tunnel. By E. N. Jacobs. June, 1929. *No.* 309.—Correcting Engine Tests for Humidity. By D. R. Brooks. June, 1929. *No.* 310. Wind Tunnel Pressure Distribution Tests on a Series of Biplane Wing Models. Part I.—Effects of Changes in Stagger and Gap. By M. Knight and R. W. Noyes. July, 1929. *No.* 311.—The Use of Wheel Brakes on Airplanes. By T. Carroll, and S. J. DeFrance. July, 1929. *No.* 312.—Sphere Drag Tests in the Variable Density Wind Tunnel. By E. N. Jacobs. Aug., 1929. *No.* 313.—The Formation of Ice Upon Airplanes in Flight. By T. Carroll and W. H. McAvoy. Aug., 1929. *No.* 314.—Spiral Tendency in Blind Flying. By T. Carroll and W. H. McAvoy. Aug., 1929. *No.* 315.—Viscosity of Diesel Engine Fuel Oil Under Pressure. By M. D. Hersey. Sept., 1929. *No.* 317.—Tests of Four Racing Type Airfoils in the Twenty-foot Propeller Research Tunnel. By F. E. Weick. Sept., 1929. National Advisory Committee for Aeronautics, Washington, D.C., U.S.A.

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AERONAUTICAL PATENT SPECIFICATIONS

(*Abbreviations:* Cyl. = cylinder; i.c. = internal combustion; m. = motor. The numbers in brackets are those under which the Specifications will be printed and abridged, etc.)

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15,697. J. MILLER. Aircraft. (322,183.)
24,003. T. B. SLATE. Method of constructing the hull of an airship, etc. (322,163.)
24,258. G. BECKER. Supercharging method for i.c. engines. (322,186.)

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942. W. ANGERMUND. Apparatus for transferring loads to and from aircraft. (322,379.)

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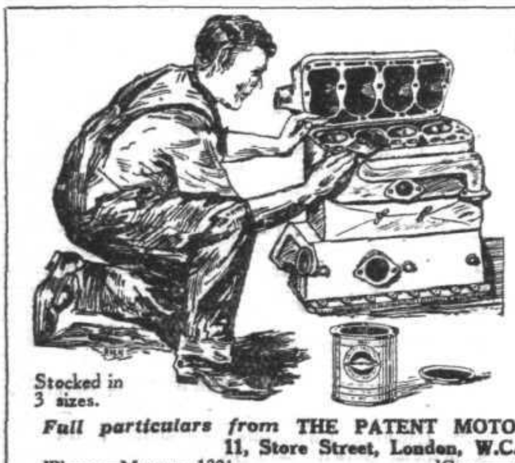

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